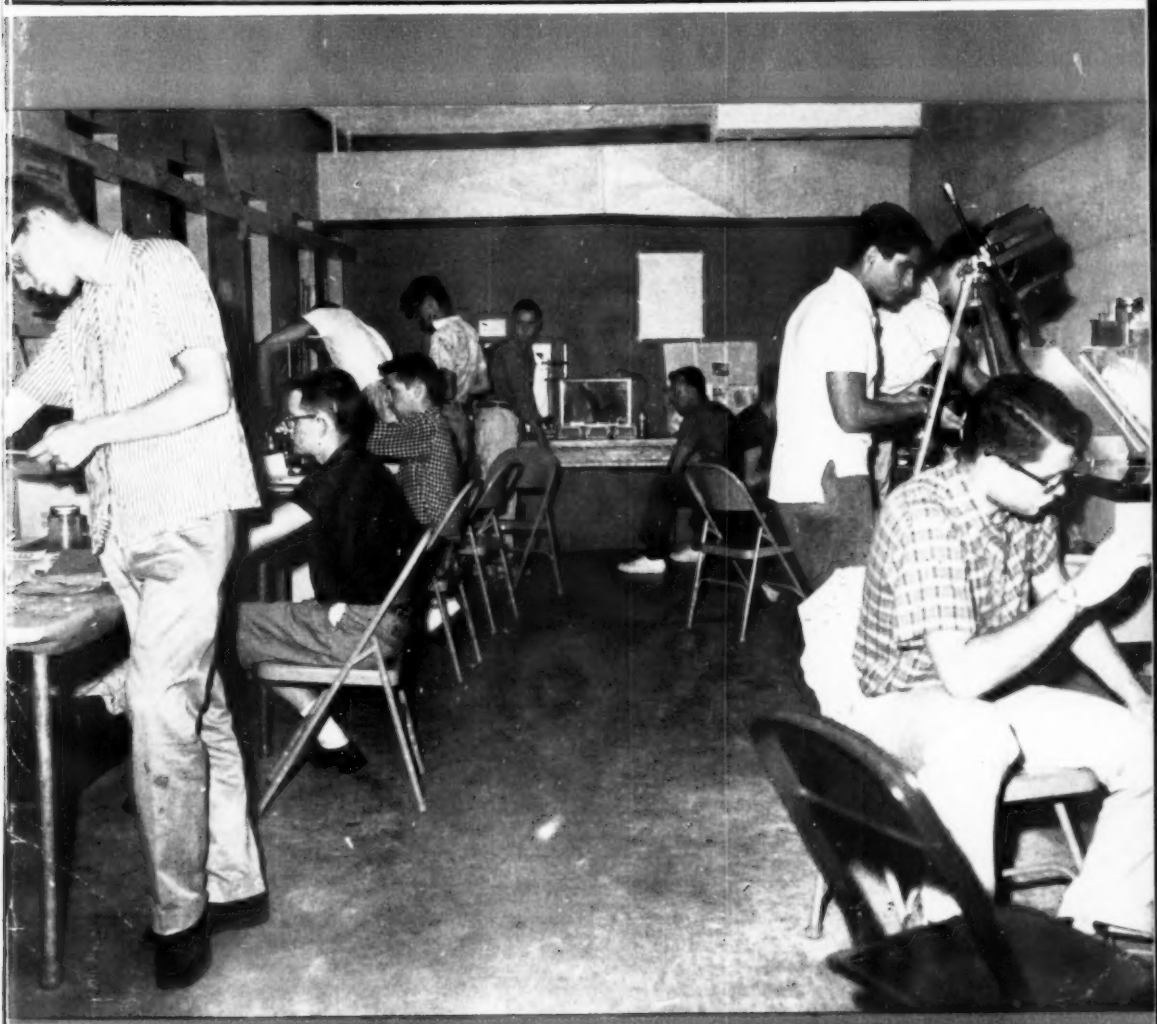
Weatherwise



Volume 12, Number 5 October 1959

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

AMS CALENDAR

Chicago, Illinois	**26–31 December**	**With the A.A.A.S.**
Boston, Mass.	**19–22 January**	**40th Anniversary**
New York, N. Y.	**26 January**	**With Institute of Aeronautical Sciences**
Santa Barbara, Cal.	**4–8 April**	**3rd Conference on Applied Meteorology**
San Francisco, Cal.	**11–14 April**	**8th Weather Radar Conference**
Washington, D. C.	**27–30 April**	**General Meeting with the AGU**
St. Louis, Mo.	**10–12 May**	**Conference on Severe Storms**
Kansas City, Mo.	**18–19 May**	**3rd Conference on Agricultural Meteorology**
Eugene, Oregon	**14–16 June**	**With Pacific Division A.A.A.S.**

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Front cover: A section of the Meteorological Laboratory during a typical session at the AMS–Loomis School Atmospheric Sciences Program.

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Students and Staff of the AMS-Loomis School Atmospheric Sciences Program.

First Row l-r: Anthony Musto; Charles Paul; Anthony McClimans; Alfred Mateczun; Robert Shiozaki; Vincent Schaefer, Academic Director; George Milligan; Page Painter; Robert Singer; John Wiles; David Mutch.

Second Row l-r: Eugene Wengert; Douglas Jewett; Joseph McCarty; Arthur Kliefoth; John Goltman; Michael Meister; Thomas Wilcox; David Schweickart.

Third Row l-r: Robert Hadsell; Hugh Field; James Schaefer, Laboratory Assistant; Theodore Smith; Henry Lanford; Thomas Defler; Louis Cutrona; Robert Bush; Ross Kelly.

Last Row: George Savage, Dean; James Carroll, Instructor; Thaddeus Zaleskiewicz, Instructor; Steven Caldwell; Harold Petrie; Robert Berry; Richard Whitfield; Jay Rosenthal, Instructor; Allan Murphy, Instructor; Douglas Carter, Assistant Director.

An Adventure in Atmospheric Science

VINCENT J. SCHAEFER, *Research Consultant, and Academic Director, 1959 Atmospheric Sciences Program*

ON Monday, 22 June 1959, a fascinating experiment in science education was initiated in a temporarily modified basement rifle range at The Loomis School in Windsor, Connecticut. On the previous day, thirty carefully selected high school students ended their travels at this Connecticut valley school, some having travelled nearly three thousand miles in their journey. Coming from fifteen states and England, the students, who had just completed their junior year of high school, were embarking on an adventure in learning which to many of them might represent an important milestone along an important career in science.

The Atmospheric Sciences Program in which they were to participate represented one effort on the part of certain members of the American Meteorological Society, prompted by a request from the Committee on Meteorology of the National Academy of Sciences, to initiate a major program toward building up the scientific manpower potential in the atmospheric sciences. Officers, members of

the Council, the Schools Committee, and members of fifty local branches of the Society all played a part in this experiment which was supported by the National Science Foundation.

The primary objective of the program was to see whether it was feasible, within the short period of seven weeks, to interest a group of keen students in the fascinating challenge offered by various phases of the atmospheric sciences. The program, as developed by the writer, was planned to stress basic research, to emphasize the breadth of the field, the wealth of problems needing attention, and the essential necessity of acquiring a broad training in physics, chemistry, and mathematics in college before specializing in some particular aspect of science.

The thirty students assembled at the school had been selected from a group of 205 applicants who had taken two special written tests some two months previously under plans developed by Dean George B. Savage of The Loomis School. All of them had been approached by members of the Society, after ascertaining they possessed outstanding academic records, unusual personality, and an attitude toward science which indicated good potentialities for important development.

Part of the program was planned to follow along the lines developed during the previous two years at the Precollege Science Center sponsored by The Dorr Foundation and The Loomis School. This included a college-type lecture on basic physics given by Professor F. W. Constant, head of the physics department of Trinity College, and a physics laboratory course related to his lecture as arranged by Professor N. Rogers of The Loomis School and assisted by the four instructors connected with the Atmospheric Sciences Program. These latter were two meteorology majors—Allan Murphy, a graduate of University of Michigan, Jay Rosenthal, a graduate of New York University; two undergraduate physics majors, James Carroll and Ted Zaleskiewicz, both of Union College.

The schedule of a regular day started at 0645 and ended at 2230. During four days of the week, an hour was devoted to physics lecture, about two hours to physics laboratory, three hours (in two periods) to laboratory and field projects of the special atmospheric sciences program, and two hours to study and library work. Interspersed were times for meals and recreation. Without exception, the students applied themselves to the program outlined and accomplished a great deal of work.

In selecting the students, no special consideration was given those showing a previous interest in meteorology. Particular consideration was accorded those who showed a broad area of interest, an avid curiosity in the natural sciences, and a reputation for enthusiasm, imagination, and individualism. In general, it was found that when the final selections were made, most of the students decided upon were those who also had outstanding academic records. About ten per cent were selected without particular stress on their academic grades. While they had some difficulty with the physics laboratory program, the rest of their activity was on a par with the remainder of the students.

Since none of the students was familiar with some of the basic experiments in atmospheric physics, the first three days of meteorological lab were devoted to conducting five experiments. These included the forming and seeding of a subcooled cloud, the visual detection of a single layer of molecules, the quantitative measurement of condensation nuclei, the measurement of atmospheric electricity, and the detection and counting of ice nuclei. Each of the thirty students personally conducted the experiments under the guidance of five staff members. These were then described in writing and checked to be sure the experiments were properly understood by all. By a concentrated effort, this initial phase of the work, including write-ups, was completed in about ten hours.

At the end of the second day, a list and brief description of sixty-three research projects were distributed to all the students. By noon of the fourth day, each student prepared a list of ten of the projects in which he thought he would be interested, listed in order of preference.

The backgrounds and interests of the students were so diverse that in all but four instances they were assigned the project of first preference. As might be expected, three of the students showed an interest in the operation of the radar unit at Bradley Field. The student whose background suggested the most competence in this field was given first choice,

while the others were assigned projects to be conducted at the airport so that from time to time they could also work with the radar. Five additional projects were developed by the director to supplement the research projects selected by students, which, because of lack of additional equipment or other technical reasons, indicated the need for a shift in objective. By the start of the second week, every student was embarked upon a research project which was to engage his attention for the succeeding five weeks.

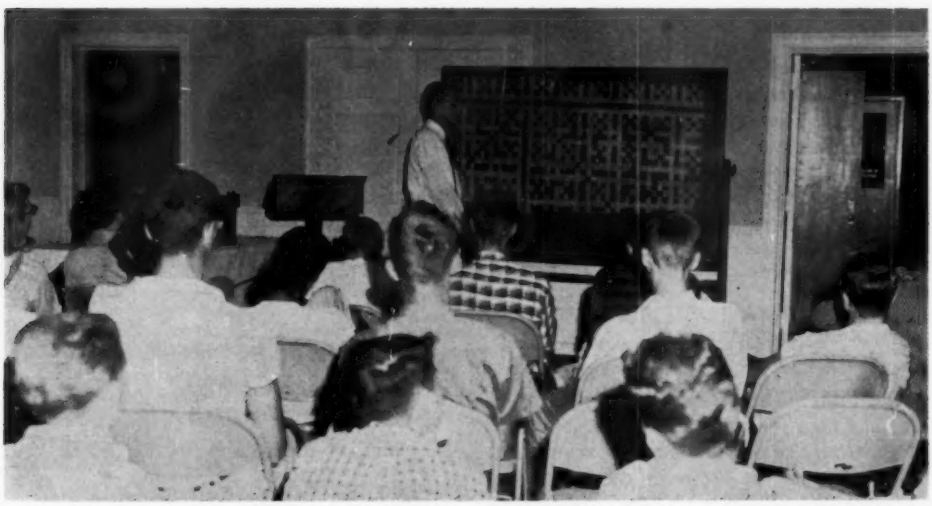
Every one of the projects was of potential importance in some phase of the atmospheric sciences. Most of them involved the use of relatively inexpensive equipment—in some cases much of it was homemade and often constructed or assembled by the student as the need developed. This approach was planned to emphasize the point that important and significant work could be done in this as well as many other fields of science by proper and imaginative use of simple and easily obtained equipment. Considerable attention was paid to photography. Many students for the first time made photomicrographs, processed their exposed film, and made prints to illustrate points in their papers.

During the fourth week, an open house was arranged so that visiting national officers and members of the Connecticut Valley Branch of the AMS could meet the students and see the scope and progress of their research projects. This was a highly successful venture and seemed to be enjoyed by students and visitors alike.

At the end of the sixth week, the students concentrated on writing up their projects and research findings. This was done in a form acceptable for scientific publication, thus illustrating proper techniques and the value of summarizing the work of a research project. Of great help in planning and guiding the students in this activity was Douglas Carter, the writer's assistant. All students agreed this was one of the most important phases of the program.

A number of the papers written by the students include important observations and new techniques concerned with the subjects studied. In several instances serendipity played a role in the research activities when several exciting new discoveries were accidentally encountered. An abstract of each student's paper, along with his school and hometown, is given at the end of this article.

At the completion of the course, each student was given a certificate in recognition of his participation in the program. A second certificate was given in the name of the American Meteorological Society in recognition of his special research project and paper. In addition, five students were selected to receive identical prizes of a recording barometer



A student-led seminar. Thomas Wilcox describes the features of a circle drawn by the axioms of the Wilcoxian Geometry he invented.

presented by Science Associates of Princeton, New Jersey. The reason for selection and the winners plus those cited for honorable mention are as follows:

RECOGNITION GIVEN TO STUDENTS PARTICIPATING IN PROGRAM

Students Showing Greatest Progress During Program
Won by:
Page Painter
Honorable Mention:
Robert Singer, Thomas Defler

Student Co-operating Best With Instructors and Students in Dormitory and Classes
Won by:
Henry Lanford
Honorable Mention:
Robert Singer

Student Showing Most Originality in Project
Won by:
Steven Caldwell
Honorable Mention:
Louis Cutrona
Thomas Wilcox
Henry Lanford
Harold Kliefoth
Douglas Jewett

Student Doing Best Job in Summarizing Project
Won by:
Louis Cutrona
Honorable Mention:
George Milligan
Henry Lanford
Eugene Wengert
Harold Kliefoth
Douglas Jewett
Page Painter
Robert Hadsell

Student Most Helpful to Others in Project Work
Won by:
Alfred Mateczun
Honorable Mention:
Henry Lanford

The value of a program such as described here has many facets. For the first time, a large percentage of the students participating in the program are aware of the exceptional opportunities available in the atmospheric sciences. While only a fraction of them are likely to major in this field, I am sure that all of them will have a much keener interest and wider understanding of it than they would have had otherwise. A large percentage of the group indicated the likelihood of continuing studies of their projects at home or in school.

Many other experiences encountered at the school will be valuable. The new outlooks in science presented by the eleven outstanding scientists who lectured to them, the field trips which showed them the beautiful New England countryside, the insides of industrial laboratories, and field research programs of forest and agricultural experiment stations, the new experiences of living in close contact with other boys having similar and different attitudes toward life and society, the contacts in the class room with teachers and one another, the recreational activities of wholesome, competitive sports, and the keen, intellectual competition of a large group of other boys of similar age, all contained intangible aspects that will be difficult to properly evaluate for years to come.

It is to be hoped that similar programs will be planned for succeeding years. Plans are in the development stage to offer "post graduate" opportunities to those who displayed the greatest interest and ability in their activities. It is hoped this can be developed to the point where the students will be able to participate in some of the most important laboratory and field projects in the atmospheric sciences underway in the United States. If this can be worked into a continuing program, and if the initial experiment at The Loomis School can be duplicated in two or three additional areas of the country, we can be reasonably sure that within a few years the atmospheric sciences will have personnel suitable to meet the essential and important research jobs that need to be undertaken. By emphasizing quality rather than quantity, we can meet any challenge that may arise in the future.

Abstracts of Research Projects

A Cloud and Atmospheric Survey of the Connecticut Valley

William L. Bush, Beaverton H. S.,
Portland 25, Oregon

The paper contains the method for finding a correlation, daily weather statistics for 21 June 1959 to

A section of the Meteorological Laboratory during the Open House held for members of the Connecticut Valley Branch of the American Meteorological Society.

31 July 1959, the steps in finding a correlation, and some of the actual correlations.

A Water-Soluble Plastic and Its Usefulness in Relation to Leaf Stomata Studies

George H. Milligan, Bellevue H. S., Belleville, Michigan

A water-soluble polyvinyl plastic called Elvanol has been tested for its suitability in the preparation of organic surface replicas. The leaf and its stomata were the organic surfaces used. The plastic was found to be very satisfactory and produced clear images without difficulty. The plastic was used to study leaf stomata when exposed to various atmospheric conditions, especially a high concentration of ozone. Several replicas of shade-grown tobacco with fleck damage have been prepared and it is observed that the surface tissues and stomata of the leaves are generally destroyed.

An ozone generator was made and several tobacco leaves were exposed to see if fleck could be produced. There have been no positive results so far.

Background Radiation and the Radioactivity of Precipitate Samples

John T. Goltman II, St. Philip H. S., Battle Creek, Michigan

In this project information was collected on background radiation and the radioactivity of precipitated sediment samples. In the section dealing with background radiation correlations were found between two unusually high counts and the appearance and disappearance of the solar upheaval of July 1959. It was also found that when the one minute readings collected in the aforementioned project were placed on a frequency-distribution graph, they formed a reasonable approximation of the normal curve. In the section of the project dealing with the radioactivity of precipitated samples some correlations were found between the level of radioactivity and the rate at which the sediment samples precipitated from a slurry.

(*Continued on page 212*)

Members of the planning committee of the new Pennsylvania Earth and Space Science Course.

Seated from left to right:

Miss Viola Phillips, Univ. of Pittsburgh, *Geographer*

Dr. John Ryan, Lehigh Univ., *Geologist*

Prof. John Lewis, Calif. State Teachers College, *Conservation*

Dr. Paul Glatzert, Penna. Dept. Public Instruction

Miss Katherine Montgomery, Greensburg High School, *Science Teacher*

Dr. John Moss, Franklin & Marshall College, *Geologist*

Dr. Lee Boyer, Penna. Dept. Public Instruction

Dr. Robert Ford, Millerville S. T. C., *Climatologist*

Dr. Francis Davis, Drexel Tech. Institute, *Meteorologist*

Dr. John Clark, Nat. Aeronautics & Space Administration, *Space Science*

Standing:

Mr. Robert Neathery, Franklin Institute, *Astronomer*

Mr. Carl Wapiennick, Buhl Planetarium, *Astronomer*

Dr. Charles Thornton, Penn. State Univ., *Geologist*

Mr. George Bowman, Hanover Jr. High School, *Science Teacher*

Meteorology in the New Pennsylvania High School Earth and Space Science Courses

JOHN H. MOSS

Dr. Moss is Chairman of the Geology Department of Franklin and Marshall College, Lancaster, Pa. He is also Chairman of the Earth and Space Science Course Advisory Committee of the Pennsylvania Department of Public Instruction.

FOR those who have long been urging that more meteorology be taught in secondary schools, there is encouraging news from Pennsylvania this year. Meteorology will comprize about one-third of the new Earth and Space science course introduced this fall into the state's public school system. Since new courses are something of a rarity in state educational systems, the story of how this course was developed and what it consists of may be of special interest.

The new Earth and Space science course is part of the Pennsylvania Department of Public Instruction's post-sputnik effort to modernize the science curriculum in the state's secondary schools. Credit for originating the idea belongs to Dr. Charles H. Boehm, Superintendent of Public Instruction, who recognized the need for a new science course to introduce students to the Space Age. To implement his idea and to develop the course, Dr. Boehm turned to Dr. Lee Boyer of the Bureau of Curriculum Services who organized a committee of 14 scientists and teachers to write the course. Representing meteorology and climatology were Dr. Robert N. Ford of Millersville State Teachers College and Dr. Francis K. Davis of Drexel Institute, a professional member of the American Meteorological Society.

At the outset, the committee reached a number of important decisions about the course: first, that it should be a "long pants" science course that could stand alongside physics, chemistry, and biology in the curriculum; secondly, that the first outline and teaching guide should be for the more gifted students from which teachers could make adaptions for less talented classes; thirdly, that the best background for entering the Space Age (in addition to physics, chemistry, and biology) lay in an improved understanding of the so-called Earth Sciences—geology, meteorology, and astronomy; fourthly, that although the course should show the interrelationship between the earth sciences, it should convey to students a clear idea of each of the individual disciplines; and lastly, that the course should make students aware of the uncertainty and challenge of science by acquainting them with some of the major unsolved problems in these fields.

After going through three drafts, many conferences, and several critical reviews, a 111-page outline and teaching guide has emerged describing what should be taught and how. The course is split into 5 sections, the middle three of which can be taught in any order the teacher desires. The first is an Introduction, showing the relationship between the Earth Sciences and providing basic data needed in each of the sections to follow. The next three sections cover geology, meteorology, and astronomy. The final section is a summary of oceanography in which once again the impact of the other sciences can be demonstrated.

The meteorology section comprising nine to twelve weeks begins with a development of the idea that "We live at the bottom of a vast sea of air" and continues with a study of the properties of the atmosphere, the instruments used to measure them, and the weather phenomena resulting from variations in them. All schools are urged to buy weather instruments, set up weather stations, and collect weather data for their communities. It is hoped that eventually a state-wide high school weather station network will evolve that will be useful to the U. S.

Weather Bureau. Atmospheric data collected by the school station will be used in class. In addition, students will learn to read and to understand the U. S. Weather Bureau daily map, sequences of which are to be studied in class. The metorology section is concluded with a brief study of climatology.

While the specialists were developing the course content, Drs. Boehm, Glatzert, head of the Bureau of Curriculum Services, and Boyer were wrestling with other problems necessary to the course's success: first, a place in the curriculum, secondly, necessary equipment, and thirdly, adequately trained teachers. Last spring the State Board of Education approved the course and the Department of Public Instruction recommended that schools either complete general science by the end of eighth grade and offer the new course in the ninth, or present it as a high-powered elective in one of the higher grades. To provide equipment, schools were authorized to purchase necessary instruments with funds supplied under the National Defense Education Act. To meet the teacher problem, Earth Science teacher certification requirements effective in 1963 were established and all colleges in the state were urged to help train new teachers for the course. In addition several colleges have applied to the National Science Foundation for summer Earth Science teachers' institutes to retrain present science teachers from Pennsylvania and other states.

The response to the new course by schools has been rather startling. For example, over 60 Pennsylvania schools have purchased meteorological equipment during the summer vacation. Schools in over 30 counties have notified the Department of Public Instruction that they plan to teach all or part of the new course this year. Others have indicated that they will expand the geology, meteorology, and astronomy parts of their present general science courses. A third group will spend this year "tooling up" in preparation for offering the course next year.

Many problems lie ahead this first year but a start has been made and the future seems to have great possibilities. Our committee would like to urge all meteorologists in Pennsylvania and other states to urge their local schools to increase their offerings in the earth sciences. With the time of man's first journey into space fast approaching, it is of prime importance that all students know more about the Earth on which they live and the realm of Space to which their future lives will be increasingly oriented. Copies of the new Pennsylvania Earth and Space science course can be secured free-of-charge from Dr. Paul Glatzert, Bureau of Curriculum Services, Department of Public Instruction, Harrisburg, Pa.

Meteorological Equipment Items

The following is the list of "A" equipment items purchasable under the provisions of the National Defense Education Act. The meteorological consultants recommended that standard U. S. Weather Bureau equipment for temperature and precipitation measurements be installed and exposed according to Weather Bureau regulations. Thus, the records would be comparable with other official records and would contribute valuable data to the climatological history of the State of Pennsylvania. The remainder of the instruments are of good quality, but less costly than standard Weather Bureau equipment. It is recommended that all schools look forward to the acquisition of a Weather Bureau microbarograph in the future.

Weather Station

Instrument shelter, U. S. Weather Bureau type, 25″ x 21″ x 18″ inside area. Max-min thermometers and holder. Sling psychrometer, range +20° to 120° F., psychrometric slide rule. Science Associates, 194 Nassau St., Princeton, N. J., Nos. 176, 111, 210, 280 or equivalent.

Rain Gage and Support

U. S. Weather Bureau 8″ diameter rain gage and tripod support. Science Associates Nos. 503, 504 or equivalent.

Barometer

U. S. Weather Bureau type, dual scale aneroid barometer, graduated to .02″ and one millibar, 5½″ dial, 2½″ thick. Science Associates No. 306 or equivalent.

Model Weather Station Kits

Unit of 5 Model Weather Stations Kits for 23 experiments on the laws of the atmosphere and basic materials to assemble 10 model instruments. 40-page handbook and 20-page teachers manual. Science Associates No. 931 or equivalent.

Wind System

Wind speed detector (cup anemometer) plus wind direction detector (wind vane) plus remote speed and direction indicators and 50′ of electric cable. Science Associates No. 409 or equivalent.

Hygrothermograph

Records temperature and humidity. Temperature range 0° to 100° but adjustable for higher or lower seasonal variations. Both temperature and humidity recorded on the same rectangular chart in different color ink. Chart period must be seven days. Science Associates No. 257 or equivalent.

Preliminary List of Books for Reading and Reference in Meteorology as Proposed by Consultants to the Earth and Space Science Course in Pennsylvania Schools

Bates, David R., *Earth and Its Atmosphere,* Basic Books, 1958

Blair, Thomas A., *Climatology, General and Regional,* Prentice-Hall, 1952

Blair, Thomas A. & Fite, R. C., *Weather Elements,* Prentice-Hall, Inc., Englewood Cliffs, N. J., 1957

Cook, J. G., *Our Astonishing Atmosphere,* Dial Press, New York, 1957

Cook, J. G., *We Live by the Sun,* Dial Press, New York, 1957

Ellison, M. A., *The Sun and Its Influence,* The Macmillan Company, 1956

Finch, V. C., Trewartha, G. T., Robinson, A. H., & Hammond, E. H., *Elements of Geography,* 4th edition, McGraw-Hill, New York, 1957

Fraser, Ronald, *Once Around the Sun,* The Macmillan Company, New York, 1957

Geiger, D. R., *The Climate Near the Ground,* Harvard University Press, 1957

Haynes, B. C., *Techniques of Observing the Weather,* John Wiley & Sons, New York, 1947

Kendrew, W. G., *Climates of the Continents,* 4th edition, Oxford University Press, 1953

Koeppe, C. C. & Delong, G. C., *Weather and Climate,* McGraw-Hill, New York, 1958

Petterssen, Sverre, *Weather and Weather System,* Vol. II, second edition, McGraw-Hill, New York, 1957

Petterssen, Sverre, *Introduction to Meteorology,* second edition, McGraw-Hill, New York, 1958

Strahler, A. N., *Physical Geography,* John Wiley & Sons, New York, 1951

Taylor, G. F., *Elementary Meteorology,* Prentice-Hall, Inc., Englewood Cliffs, N. J., 1957

Trewartha, G. T., *An Introduction to Climate,* third edition, McGraw-Hill, New York, 1954

Textbooks

No textbook has been found that is completely satisfactory for the course. Several publishers are considering producing during the coming year books which will have the same breadth and depth of coverage as the course. Two currently available texts are: G. L. Fletcher and G. W. Wolfe, *Earth Science,* 4th ed., D. C. Heath and Co., Boston, 1959, and S. N. Namowitz and D. B. Stone, *Earth Science,* D. Van Nostrand and Co., Princeton, 1959.

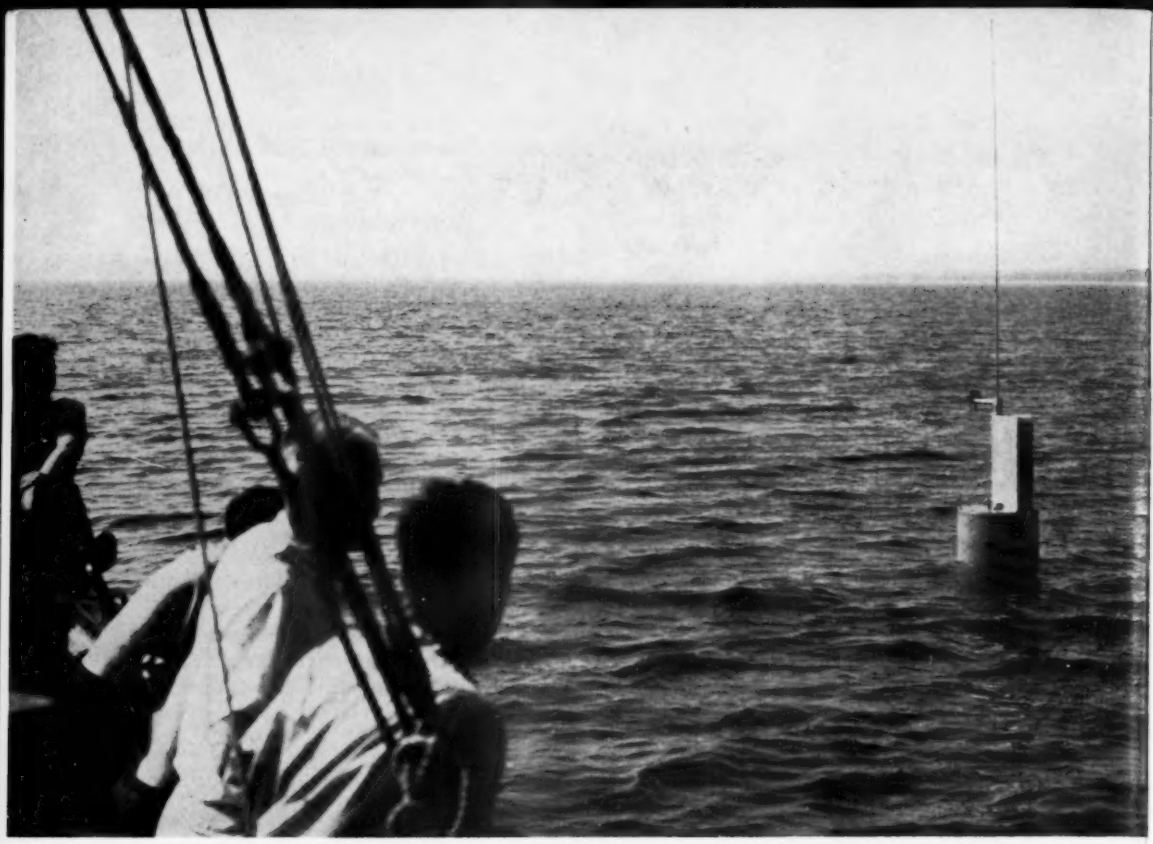


FIG. 1. The free-floating transobuoy undergoing tests in the Hawaiian Islands area. U. S. Navy photo.

The Floating Automatic Weather Stations of the United States Navy

E. F. CORWIN, J. C. APPLEBY, AND L. J. ALLISON, *Aerology Division, Bureau of Aeronautics, Department of the Navy*

TO meet the problem of gathering weather reports where there are no human observers, the U. S. Navy is developing several different types of floating automatic weather stations. In order to analyze and forecast the weather successfully, it is necessary to know what changes are occurring in the atmosphere at all places and at all times, even though some of the places are uninhabited, inaccessible, or just vast ocean areas. Ocean areas, such as the Pacific, are presently coming under very close scrutiny in the planning of weather networks for the future, because of the inadequacy of the present observations from these areas.

TRANSOBUOY SYSTEM

One of the more interesting of the floating weather buoys is the transobuoy, a free-floating automatic weather station developed by the Naval Research Laboratory for use anywhere in the North Atlantic or North Pacific Ocean. The main body of the buoy is ten feet in length, 22 inches in diameter, and approximately 600 pounds in weight. Using a 25-foot whip antenna with an average power

rating of 100 watts ICW (interrupted continuous wave) the weather buoy is expected to give reliable nighttime transmissions up to 4,000 miles. The transmitter contains control and programming circuitry, so call letters and a long dash are transmitted before the sequence containing the meteorological information. The frequencies of 15,026.0 kc are now being used for daytime transmissions and 9,009.5 kc for nighttime. These frequencies were selected as the best available for the required ranges. At present, daytime transmissions are reliable over 1,000 to 2,000 miles, while nighttime transmissions are heard up to 4,000 miles. The whip antenna is a reasonably good approximation of a quarter wave antenna on the lower frequency and about $\frac{3}{4}$ wave antenna on the higher frequency. The meteorological information transmitted consists of barometric pressure, air-temperature, sea-water temperature, wind speed, and wind direction. The battery supply provides for an operating life of approximately six months when transmissions of three-minute duration are programmed on a six-hourly schedule. These transmitted signals have to be strong enough so radio direction finding stations on shore can obtain reliable bearings on the free-floating buoy, thus fixing its location every 12 or 24 hours, depending upon how fast the ocean currents are moving at that particular location. The free-floating transobuoy, together with the RDF and Shore receiving stations, make up what is known as the Navy's Transobuoy System.

The preliminary testing of this system took place in 1957 with the transobuoy first anchored and later cast adrift off the Island of Oahu in the Hawaiian Islands. Forty-one transmissions were monitored over a ten-day period with receiving stations up to 5,000 miles away, such as the one used at Laurel, Maryland. Indications are that the transobuoy can transmit atmospheric pressure, wind speed, wind direction, air-temperature, and sea-water temperature by means of coded radio signals reliably at night over transmission distances of 3,000 to 4,000 miles. Figure 1 shows the free-floating transobuoy being placed over the side and set adrift off Oahu, Hawaii. Figure 2 shows the transmitters, program timer and other electronic components with main cover removed. The

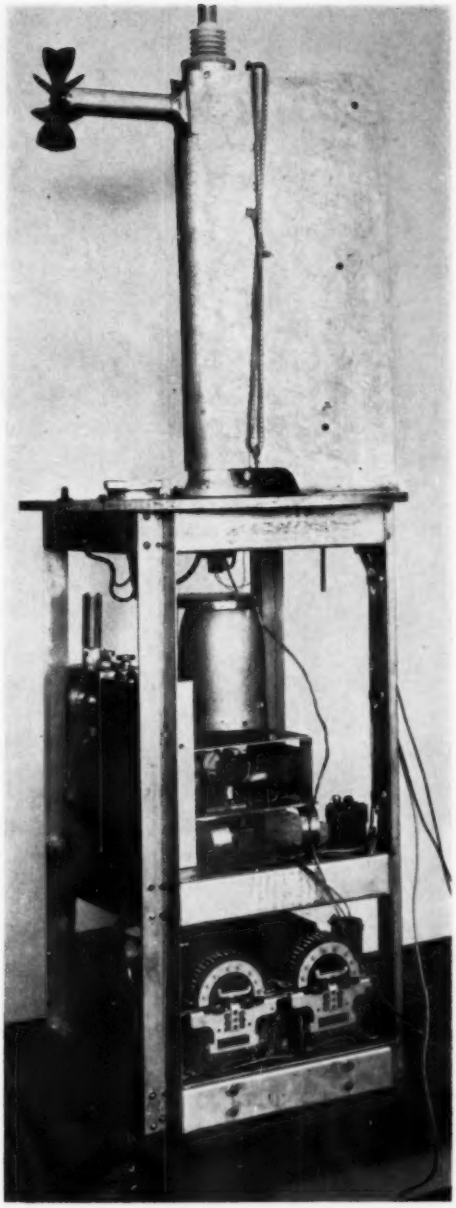


FIG. 2. The transobuoy, with case removed to show mechanical and electronic components. U. S. Navy photo.

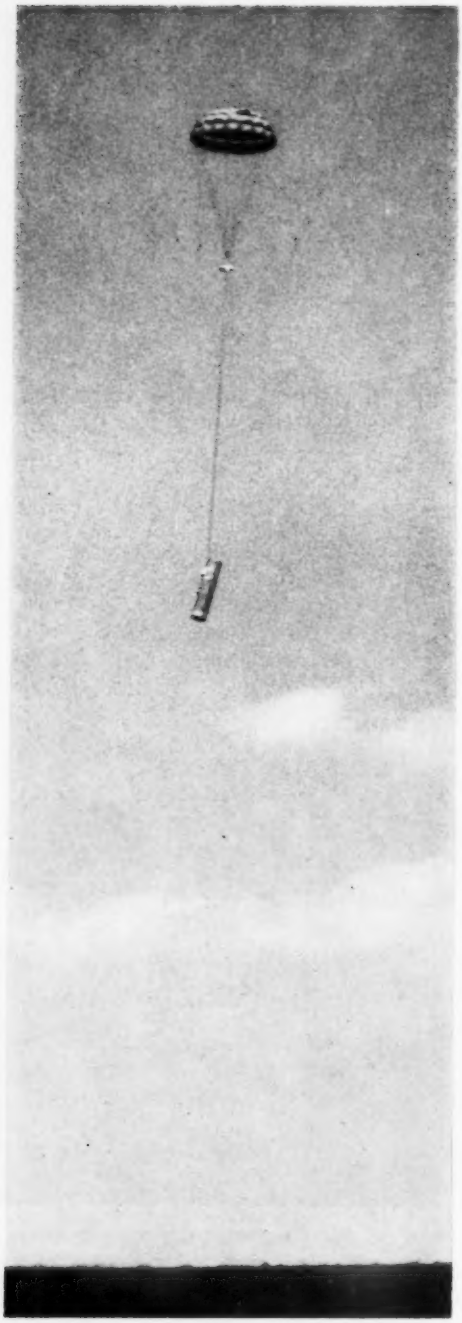


FIG. 3. The parachute weather buoy after a low altitude release from a U. S. Navy aircraft. U. S. Navy photo.

anemometer and orienting wind-vane show in the top part of the photograph. The orientation of the buoy in the water, produced by wind action on the vane, is automatically referred to a magnetic compass to determine wind direction.

The Navy has also developed a floating constant-level balloon system to obtain trajectories of air parcels, upper-air wind data, atmospheric pressure, and eventually, air-temperature and humidity. This development, known as the Transosonde System, collects meteorological data from balloons floating over the Pacific and Atlantic Oceans at 35,000 feet. If the Transobuoy System, gathering surface weather data, is used in connection with the Transosonde System, gathering upper-air data, much needed meteorological information over ocean areas can be furnished weather analysis and forecast centers.

PARACHUTE WEATHER BUOY

The Navy's general-purpose weather telemetering buoy, which can be air-dropped, was developed by the Naval Research Laboratory from an earlier model known as the "grasshopper-type" station, which was parachuted from aircraft for use on land. By taking some of the better features from the "grasshopper" and a free-floating weather buoy known as the "Hurricane Monitoring Buoy," the current model of the parachute weather buoy has evolved. The present parachute weather buoy is 10 feet long, 22 inches in diameter and weighs approximately 350 pounds. It is designed to operate for two months on a six-hourly schedule with a 20-watt transmitter. Station identification, wind speed, wind direction, barometric pressure, air-temperature, and sea-water temperature are telemetered in five-letter Continental Code groups during the three minutes that the station is on the air. Three spare channels are also available for adding other sensors as desired. A 12-foot parachute-erected, telescoping antenna has been developed and successfully tested.

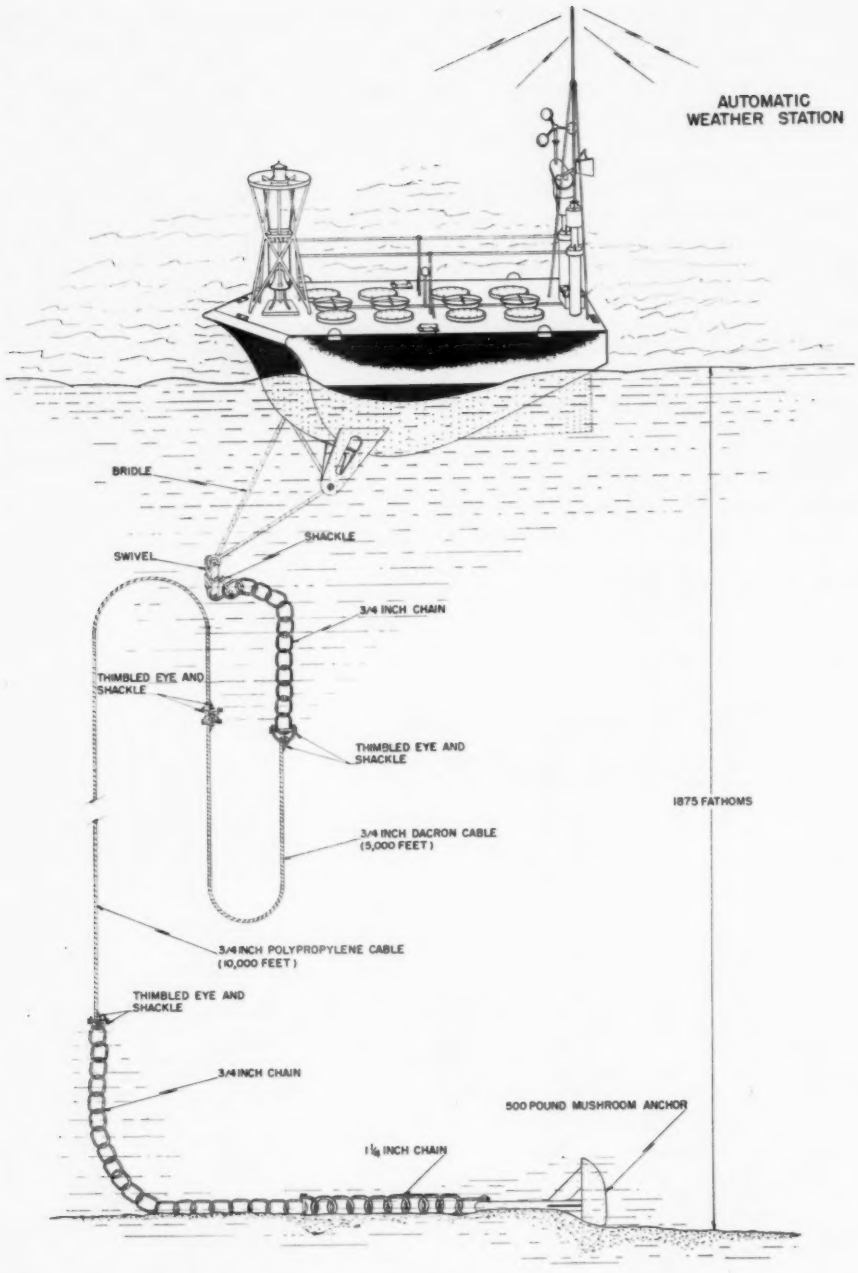
The parachute weather buoy has undergone several drop tests from aircraft. Although some damage was sustained upon water entry on the first two parachute delivery tests, these components have been re-designed, and successful delivery from aircraft has been made.

These tests indicate that parachute delivery of the buoy can be accomplished without entailing shocks greater than 20 g, if the aircraft speed at release is kept down to 150 knots. Since the casing and electronic instrumentation have been designed and initially tested at higher shocks, no difficulty was encountered in the final drop tests. Figure 3 shows the weather buoy entering the water after being parachuted from a height of approximately 500 feet. For obtaining weather data from an area where none is available, the parachute weather buoy can be delivered and placed at the exact desired location by aircraft in a relatively short interval of time.

Boat-Type Automatic Weather Station

The Navy Boat-type Automatic Weather Station AN/SMT-1 is constructed of aluminum alloy and other non-magnetic materials throughout. It is 20 feet long and has a 10-foot beam. Two masts, a large flashing beacon, a buoy-type bell, and a railing form the superstructure. However, four water-tight wells extending below deck hold the complex electronic components which are assembled in compact units. Each unit can be removed and replaced independently. Eight other water-tight wells are used for the battery supply, which consists of storage batteries used by the U. S. Coast Guard for floating buoys, or additional electronic instrumentation when required for oceanographic measurements in addition to weather data. Figure 4 shows the boat-type automatic weather station with hatch covers open and electronic components partly removed from the instrumentation wells. The hull for the boat station was designed by the David Taylor Model Basin and fabricated at the Philadelphia Naval Shipyard. The electronic instrumentation, including a master timer, program timer and element selector, bridge amplifier, code selector, code generator, pulse generator, keyer, buffer amplifier, and final amplifier, for timing and telemetering the

Fig. 4. The boat-type automatic weather station with hatch covers removed to show the electronic components. National Bureau of Standards photo.



DEEP-WATER SLACK-LINE ANCHORAGE FOR BOAT-TYPE AUTOMATIC WEATHER STATION
ANCHOR SYSTEM BY
WOODS HOLE OCEANOGRAPHIC INSTITUTION

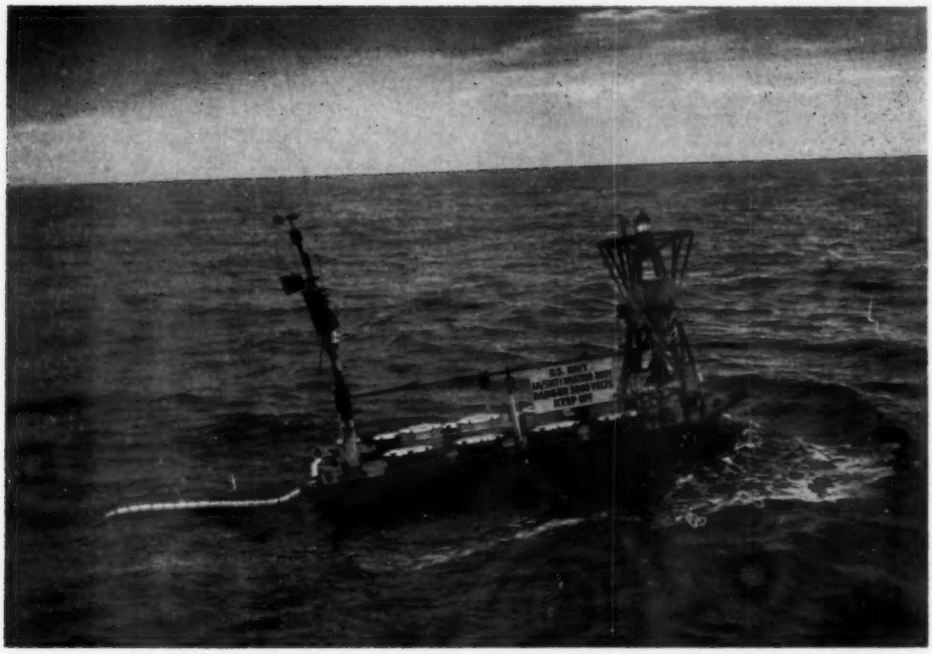


FIG. 5. A boat-type automatic weather station anchored at 25°N 90°W in the center of the Gulf of Mexico. Department of Defense photo.

meteorological information to the nearest shore receiving station, have some rather unique features in the design. The meteorological and electronic instrumentation was developed for the Navy at the National Bureau of Standards by Percival D. Lowell and William Hakkarinen.

Before the boat-type automatic weather station was transported to the Gulf of Mexico for evaluation of its performance, the transmitter was completely rebuilt for the Navy by the U. S. Coast Guard at Curtis Bay, Maryland. The design for this modified transmitter was still furnished by the electronic engineers of the National Bureau of Standards. The modification provides for a peak power of five kilowatts from a pair of 7034/4X150A tubes in push-pull. The average power has been stepped up to approximately 200 watts. As in the previous one kilowatt pulsed transmitter using a 3E29 tube, the output signal is crystal controlled at the presently used frequency of 5340.0 kc in the form of pulses having a duration of 200 microseconds and a pulse recurrence frequency of nominally 200 pulses per second. These pulses are then transmitted as groups of pulses in which the number in one group is three times the number in the second group. This grouping of pulses acts as a time modulation to form the dots and dashes of Continental Code which are transmitted at a rate of twenty words per minute. At this word speed, the dot is composed of 12 individual 200 microsecond pulses and the dash is composed of 36 such pulses. Thus, the "dits" and "dahs" heard on the standard receiver without a beat frequency oscillator have a characteristic tone of 200 pulses per second as part of the letter characters which form the Continental Code system. This characteristic tone permits identification of the signal without requiring the listener to wait to hear a particular call-letter group.

The boat-type automatic weather station is presently sending out weather reports to shore receiving stations every six hours on its assigned frequency of 5340.0 kc. But before this could be accomplished a considerable amount of research effort went into the

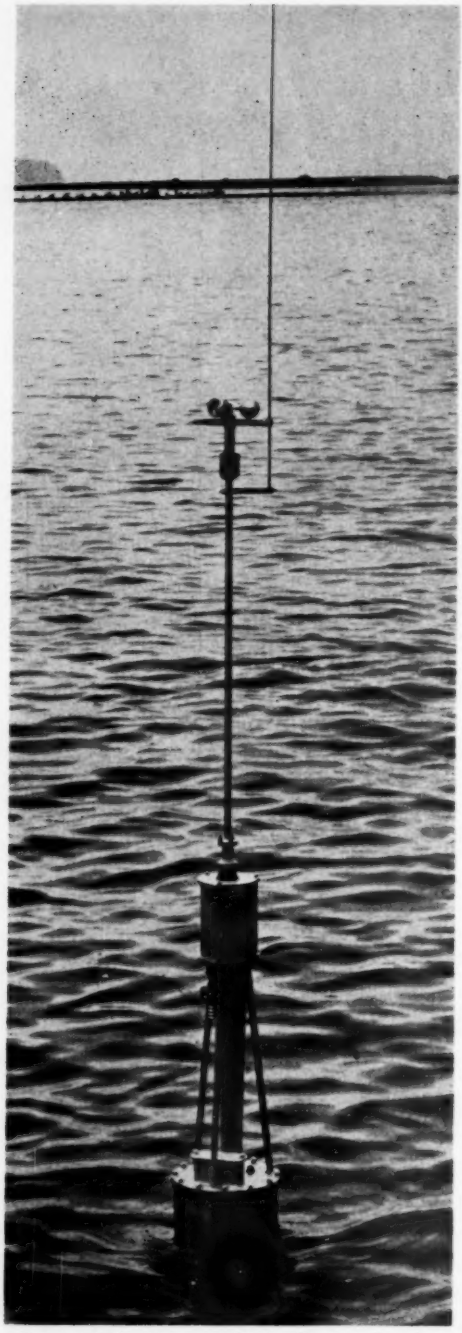


FIG. 6. A hurricane monitoring buoy undergoing evaluation in the Chesapeake Bay area. National Bureau of Standards photo.

solution of providing a stable anchorage for the station at 25° N and 90° W, or directly in the center of the Gulf of Mexico. Here the Gulf is some 2,000 fathoms, presenting a rather formidable job to provide safe anchorage at this particular location. The Woods Hole Oceanographic Institution solved the problem for the Navy. By the use of a ¾-inch polypropolene semi-buoyant cable 10,000 feet long this was successfully accomplished. Referring to Figure 5, the sketch shows first the yoke directly attached to the hull; then swivels and shackles with 100 feet of ¾-inch chain; 5,000 feet of ¾-inch dacron cable; a section in the form of an "S" to give slackness to the cable where the buoyant polypropolene line is connected to the non-buoyant top section of the cable; then the main 10,000-foot ¾-inch polypropolene cable ending with a thimbled eye, shackles, 225 feet of ¾-inch chain connected to a 500-pound mushroom anchor. The mushroom anchor and most of the 225 feet of chain lie on the bottom of the Gulf. So far this anchorage has withstood all storms. The real test of the efficiency of this system will occur when the boat station has to ride out a hurricane, probably sometime during the 1959 hurricane season.

The boat station is being monitored by Federal Communications Commission stations all the way from Florida to Michigan. In addition to this, the U. S. Weather Bureau is cooperating with the Navy, and has established two "listening" stations at Burrwood, Louisiana, and Brownsville, Texas. The Navy's receiving station for the boat-type weather buoy is located at the U. S. Fleet Hurricane Forecast Facility, Miami, Florida. With these receivers tuned to the weather station in the middle of the Gulf, it is believed some advance warning would be received before a severe tropical hurricane struck the coast, such as "Audrey," which roared into the Texas-Louisiana coastline in 1957, producing a major inundation all along the coast. Yet, the attempts to analyze the development of the hurricane storm tide by meteorologists have been severely handicapped by the lack of sufficient observational data out over the Gulf of Mexico. The boat-type automatic weather station should now furnish vitally needed meteorological information from this area.

Hurricane Monitoring Buoy

A free-floating weather buoy, somewhat similar to the transobuoy described in the first part of this article, but developed specifically as an expendable buoy for tactical use in connection with hurricane and typhoon monitoring and forecasting services, is called the Navy Hurricane Monitoring Buoy. Models of this buoy have been used in the Atlantic Ocean three to four hundred miles east of Florida as sentinels to warn shipping and the mainland against the approach of hurricanes. This type of buoy, although still in the evaluation stage, holds promise of being a useful tactical device.

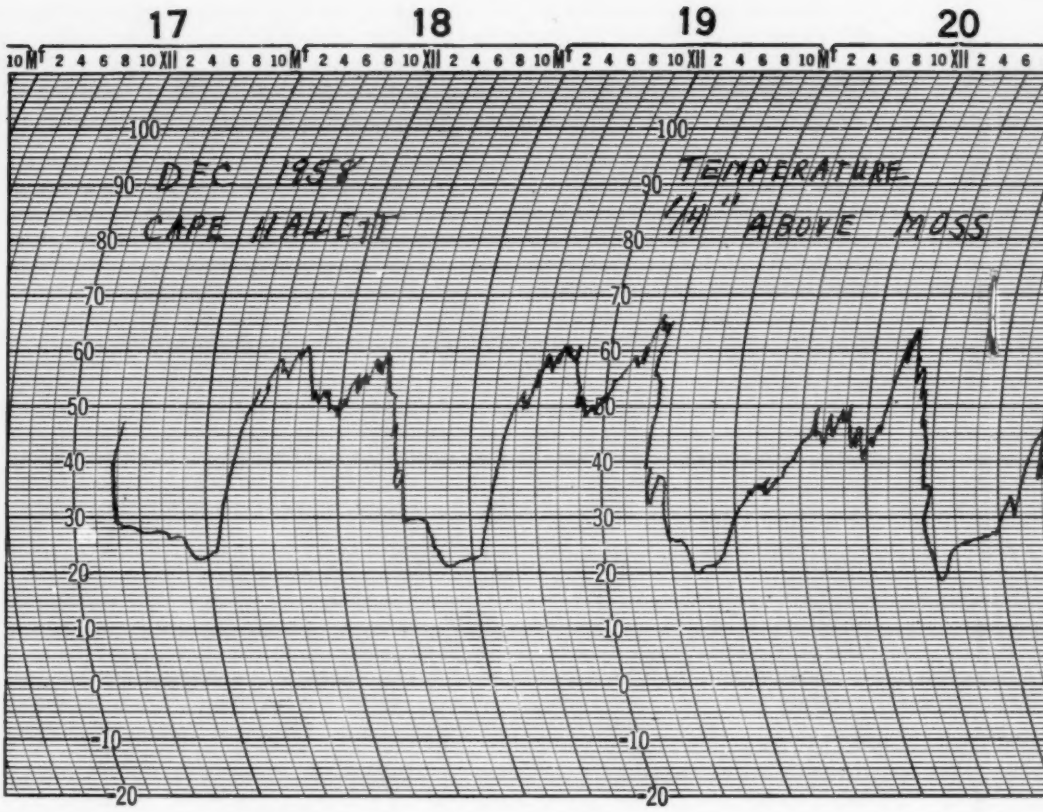
The hurricane monitoring buoy was developed for the Navy in 1955 by the National Bureau of Standards and the Naval Research Laboratory working together on the problem. The following year this design was improved by the National Bureau of Standards and presently consists of a 16-inch diameter cylindrical buoy six feet in length supporting an instrumented mast and a counterpoise weight. The counterpoise weight is an eight-foot tail frame ending in 40 pounds of lead ballast fastened to the tail frame. On top of the cylinder is a nine-foot superstructure containing the atmospheric pressure and air-temperature sensors, the anemometer and seven-foot whip antenna making the overall length 30 feet. An air vane fastened to the superstructure orients the cylinder in the water with respect to the wind. This position referred to a compass inside the buoy gives the wind direction. A resistance thermometer fastened to the inside of the buoy casing below the water line gives the temperature of the seawater.

Figure 6 shows the part of the weather buoy that extends above the surface as it floats wherever ocean currents may take it. The photograph was taken during preliminary tests in the Chesapeake Bay area. With its seven-foot antenna the transmitter was designed to obtain a maximum of effective radio-frequency power output for long-range communication with a minimum power input from a limited-energy battery-power source. With this type of transmitter the weather buoy has telemetered meteorological information consisting of atmospheric pressure, air-temperature, sea-water temperature, wind speed, and wind direction in a pre-determined sequence every six hours for two months. The buoy has been heard reliably at distances of 800 to 1,000 miles. However, to determine the location of the buoy as it floats in the ocean, bearings must be obtained by shore radio direction finding facilities in order to 'fix" the location. The distances that reliable bearings have been obtained are slightly less than the distances at which reliable weather data can be intercepted and copied. At present, it is believed that this floating hurricane monitoring buoy has a reliable capability of 800-mile operation over a two-months period.

Two of these weather buoys have also been anchored in the Gulf of Mexico at locations two and four degrees of longitude closer to the coastline of Texas than the large boat-type automatic weather station now located at 25° N and 90° W. This will give the free-floating buoy the same kind of endurance test the boat-type station is now being subjected to.

During both the 1955 and 1956 hurricane seasons free-floating weather buoys were launched some 300 miles off the east coast of Florida and in some sections of the Gulf of Mexico and the Caribbean Sea. One of the buoys was placed approximately 200 miles ahead of Hurricane Janet in 1955 by the *U.S.S. Roanoke,* a Navy cruiser that was in the Caribbean at the time. Hurricane Janet was the very vicious tropical hurricane that destroyed life and property in the Yucatan Peninsula of Mexico a few days after the cruiser placed the weather buoy in the Caribbean ahead of the storm. The cruiser received regular weather reports from the buoy until the eye of the hurricane was within approximately 60 miles of the buoy's location, when the transmissions suddenly terminated. This was probably due to a broken antenna, but before this happened the ship had received some very vital weather information. The buoy for this operation had been programmed for transmissions every two hours.

With this wide variety of floating automatic weather stations, the United States Navy will be able to gather much needed meteorological information from areas that today have very few or no weather reporting stations.

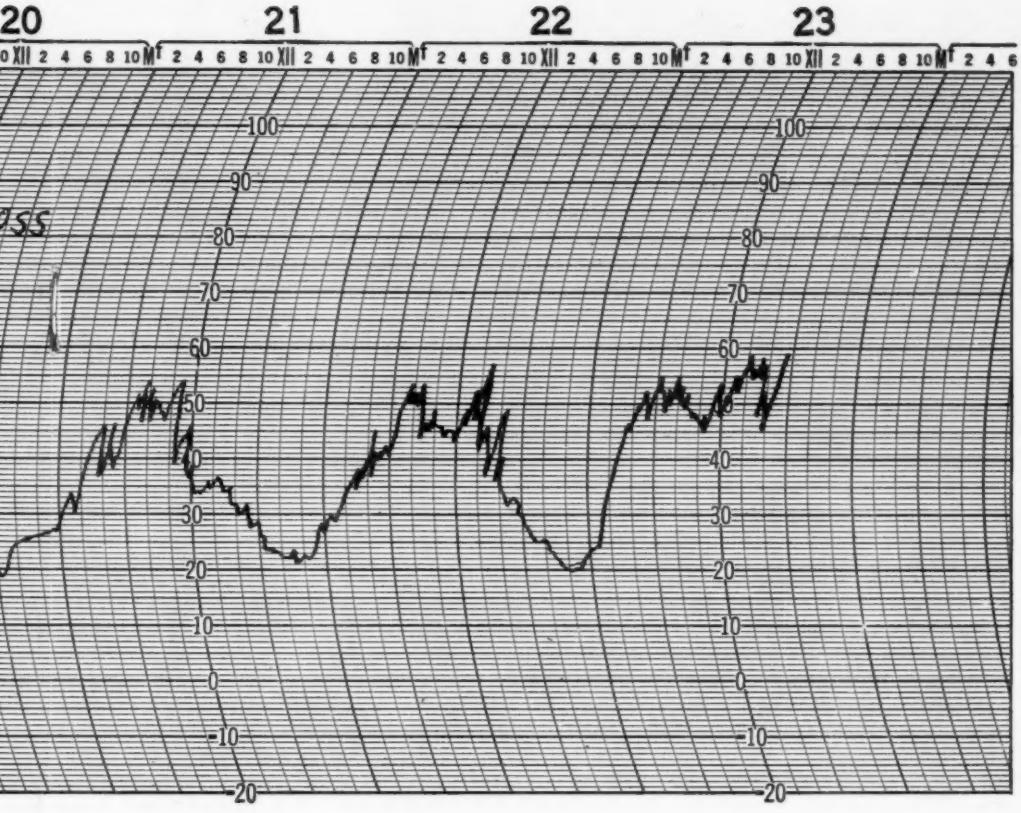


Inside Antarctica No. 4—The Hallett Story

NORMAN S. BENES, *U. S. Weather Bureau*

AMID the scenic grandeur of the Admiralty Range along the western side of the Ross Sea is a barren flat promontory, slightly above sea level, Cape Hallett. For hundreds of years this area has been home to countless thousands of penguins. For over two years this headland, and the guano-covered sandspit alongside, has been home to a handful of Americans and New Zealanders, the only joint station in operation during the International Geophysical Year.

Hallett homesteading was not easy. The first year, the Navy cargo ship, *Arneb*, was punctured severely by storm-tossed ice. While this ship was being holed, the escorting Coast Guard icebreaker was battling a shipboard fire. After the 60-knot winds had abated, unloading was accomplished swiftly, and the



Thermograph trace of temperature one-quarter of an inch above moss at Hallett Station, Antarctica, from 17–23 December 1958. Temperature in degrees Fahrenheit.

U. S. Navy Seabees started construction of the buildings. The station was formally dedicated on 9 January 1957, only seven days after the entrance to Moubray Bay had been forced.

The pioneering group of four weathermen, headed by Dr. James A. Shear on leave from the University of Kentucky, performed yeoman work in establishing the weather station. Completely instrumentated, the station took three-hourly surface and twice-daily upper-air observations. Operational difficulties hampered the solar radiation program during 1957 and were not completely eliminated until August 1958. In addition, hourly surface observations were taken during periods of aircraft activity. Hallett is on the air route from New Zealand to the Naval Air Facility

The Admiralty Range with Mt. Sabine (11,300') in the center which formed the western horizon of Hallett Station.

at McMurdo Sound and serves as a key point in flight planning and navigation for this route.

Although Hallett had the smallest meteorological staff, only four, the weather activities were only slightly less ambitious than those planned for the larger US-IGY stations.

The meteorological tower was erected in 1958 and soil temperature measurements began in April of that year. The tower provided a profile of wind velocities at the two and ten meter levels. The connecting of thermohms through a three-pole switch permitted a sample of the soil temperature at ten and fifty centimeters below the surface to be recorded on the ambient air trace four times daily.

The two years of climatic records from the Hallett station provide interesting studies. The mean temperature of the two years is an identical 4.6 degrees F above zero. The extreme temperatures are almost equally spaced about the zero mark: a $+42°$ and a $-44°$. The annual march of temperature displays an anomaly in June, when cooling is temporarily halted. The coldest month is July, just a little below August. The mean temperature gradually rises from August, reaching the highest in January.

June is the stormiest month and the aver-

The Admiralty Range under different meteorological and lighting conditions.

age wind speed is at a maximum. In 1957 the mean wind speed was 17 knots; in 1958, 15 knots. Masked in the averages are alternating periods of calm or near calm days, followed by periods of strong winds. The mean wind speed for October is only 12 knots. However, a three-day storm late in the month produced sustained winds of 80 knots and a peak gust of 99 knots. June of 1958 had three storm periods when the peak gusts were 80 knots.

When talking about wind, the location of the camp, oriented NE-SW at the seaward end of a "V" shaped valley, must be mentioned. The valley and the water-ice floor widen as progress toward the Ross Sea and the northeast is made. Beyond the southwestern extremity of the valley, the terrain begins its gradual rise to the ice-covered Victoria Land plateau where elevations reach 8,000 to 10,000 feet after a few hundred miles. This terrain feature favors the observed constancy of wind direction.

Although the annual prevailing wind direction is southwest, there is a notable deviation in the month of December. Beginning in late November and even into December of 1958, there was a distinct sea breeze; this resulted in a prevailing northwest wind. Sea breeze, tide, and ice movement were rather closely connected during the period. Shortly after the onset of the sea breeze and the beginning of the diurnal tide, loose ice would drift from the Ross Sea into the Bay.

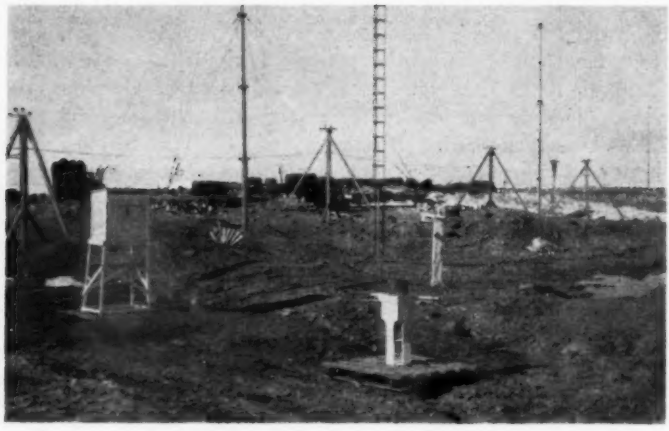
Closely connected with the wind and general storm conditions is the precipitation pattern. A period of strong winds always appeared to follow a snowfall. Also a general temperature rise either preceded or accompanied the advent of snow. As is usually the case, it was extremely difficult to determine accurately when the falling snow ended and the blowing snow began. The possibility of a thermal low forming due to liberated heat appears to be a subject for future study. Examination of the precipitation record discloses, for the two years, a late summer-early fall maximum with another near-maximum during the early winter. This indicates a continental type, but with some maritime influences. In arriving at this conclusion, the storm of 20–22 October 1957 is regarded as anomalous. It is interesting to note that 1958 produced approximately 25 per cent less precipitation than did 1957.

With periods of strong winds, it is correct to assume that snow cover on the ground was sparse. Except for the drifts that piled around the buildings, in the doorways, and even through small cracks in the walls, snow cover was not too great a problem. Movement out-of-doors, however, during periods of high wind-driven snow was extremely difficult. During the October 1957 storm, movement outside was virtually impossible. Early warming had softened the bare and rocky ground. Flying debris included small rocks and gravel. Windward facing surfaces were abraded severely. Graining of wooden objects was common and a windshield was so pitted that replacement was necessary. In 1958, there were three storm periods when stout line was strung from building to building. A system of checking in and out via the teletalk was also initiated.

The prediction of these storms seemed to hinge upon the appearance, at the 500 millibar level, of a northeasterly flow. The 1957 group passed this information to the relieving group headed by your author. This local forecasting guide was subsequently studied and expanded to add the "rule of thumb" proviso that the depth of the northeasterly flow would be an indication of the severity and duration of the storm: the deeper the flow, the stronger and longer lasting.

The period when close weather support was required during the rescue operations incident to the October 1958 Globemaster accident at Cape Roget, about 35 miles north of Cape Hallett, provided an opportunity to critically test these empirical rules. The earliest fly-in of the rescue helicopter and the Otter assigned as cover was delayed because of current weather and raob flight indications of possible worsening weather. This was a difficult decision because injured were still on the hill and the ground rescue party was halted. Again, after the mission was completed and all support aircraft were ready to depart, the

A general view of the buildings at Hallett. Note fence of fuel drums at right, a futile attempt to keep inquisitive penguins out of the camp area.



The Instrument Complex —Hallett 1958.

Radiation instrumentation at Hallett 1958 with Eppley pyrheliometer at left, Weather Bureau photoelectric sunshine switch in center, and Beckman & Whitely radiometer at right.

opportunity arose to test the hypothesis. Some blocking action, apparently, delayed the arrival of the predicted storm by about 36 hours. While operations were in progress, recourse to Little America Weather Central Analysis was made.

Earlier Hallett was used in another of its capacities, as an emergency landing strip. The diversion of four Globemasters and an R4D to the ice runway was necessitated by a storm's closing the air facility at McMurdo Sound. The pilots landing the huge four-engined aircraft were enthusiastic regarding the smoothness of the strip. During the last half of 1958 there were never any threats of the strip moving out to sea. The maximum thickness of the ice was 76 inches. The last measurement, about the middle of December, had a top layer of 26 inches of dry ice and the remaining 40 inches of wet ice.

As is the case in nearly all mountainous regions, some spectacular cloud formations may be expected. The clouds at Hallett were lenticulars. The most spectacular of this variety formed over Cape Roget. The cloud consisted of many layers of lens-shaped masses. In appearance it was similar to the one reported by Reed over Mt. Rainier.[1] Our vantage point showed the cloud to be dark. This may have been due to available light; other lenticulars were the usual white. During 1958 it was noted that Cape Roget seemed to be a favored location for the formation of these clouds. Others would form, occasionally, as scarf clouds around Mt. Herschel about 17 miles directly west of the station. Note that Mt. Herschel is about 11,500 feet, while the Cape Roget area does not exceed 4,000 feet.

Towering cumulus would form over this high ground north of the camp. Bases were estimated at around four or five thousand feet with tops close to fifteen thousand feet. No direct reports regarding the tops were available, however. The trail party from the interior in February 1958 reported towering columnar cumulus that popped up over snow-free areas.

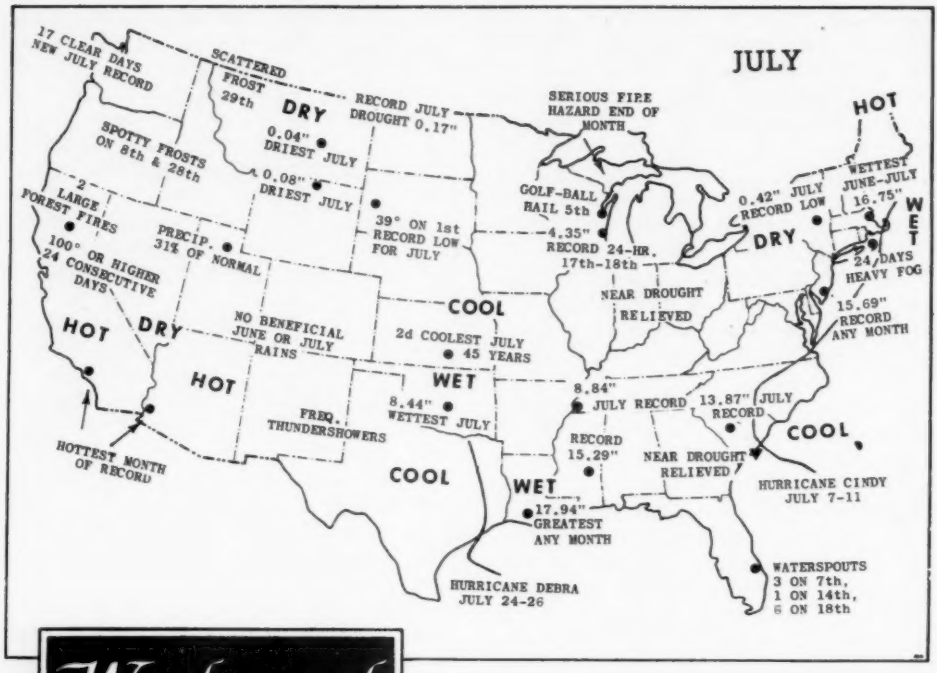
The solar radiation program, as mentioned earlier, was slow in getting underway. Nevertheless, the final six months of the IGY period contain some interesting radiation data. During late November, based on pyrheliometer data only, radiation received over an approximately 20-hour daylight period with nearly clear skies is about the same as that received at a southwestern United States desert station under about the same conditions, of the order of 800 langleys per day. A comparison of pyrheliometer and radiometer data indicates that on the average the pyrheliometer is sensitive to about 80 per cent of that recorded by the radiometer. The instruments were located in an area where the surface changed. Albedo measurements for the various covers indicate that those at Hallett agree with the generally recognized normals for the various surfaces; i.e., new snow, old snow, bare ground.

Soil temperatures at Hallett were taken at the 10 and 50 centimeter depths. The buried thermohms, close to the solar radiation equipment, were completely drifted over by July 1958. The first months of record are those of temperatures under a gradually increasing blanket of snow, which reached a thickness of five feet before being bulldozed off in August. The removal of this blanket was responsible for a sharp temperature drop. Temperatures at 50 cm approached but did not get above the freezing point, indicating that permafrost in the measurement area was about 20 inches below the surface.

Beginning in December 1958, a thermograph was installed over a moss area east of the camp to determine the order of temperatures available to these plants. The sensing unit was approximately ¼-inch above the moss surface and normal to the prevailing southwest wind. A temperature as high as 68 degrees was recorded. A few weeks of these records are available and it is hoped that this program will continue.

In April 1959 a balloon-borne radiometer program, conducted jointly with the Pole station, was started to give measurement of the radiative cooling during the polar night. It is hoped also to institute a program of measurement of total and surface ozone content. The results of these and other observations gathered at Hallett should be of great significance, not only in basic studies of meteorology, but also in providing better weather advice for traffic to and from New Zealand.

[1] Reed, Richard J., "Flying Saucers over Mt. Rainier," *Weatherwise*, Vol. 11, No. 2, April 1958.



Weatherwatch

Data by Office of Climatology, USWB.

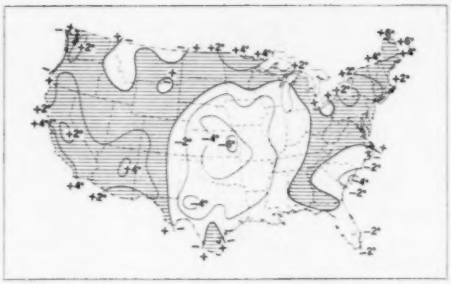
A Memorable Summer

DAVID M. LUDLUM, *Editor*

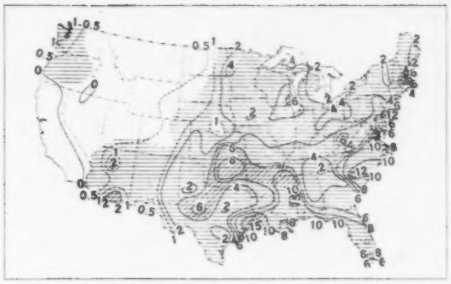
The mid-month of the summer season ably demonstrated the controlling influence which the wave action of the normal westerly flow exerts on the weather across the nation. Throughout July an unusual summer pattern persisted over the United States. From a persistent ridge over the Pacific and Plateau States, air flowed southeastward into a broad trough over the central valleys, and then swept northeastward to a flat ridge extending well out in the Atlantic Ocean. Throughout the month warm, dry air covered most of the Western States; cool, dessicated continental air dominated the central sections; and moist, maritime air, of varying thermal content, held sway over eastern areas. With the nation divided into three main climatic zones, there occurred record-breaking heat in the far Southwest, abnormal cold in the central Plains, and excessive cloudiness and heavy rainfall along the Atlantic Coast.

CIRCULATION—Almost every weather chart of the month showed an expansive low pressure system over northern Canada and Alaska with mean pressure departures very marked over the Western Hemisphere portions of the Arctic. An active surface vortex persisted in a mean monthly position just northwest of Hudson Bay and aloft a similar feature was found over Baffin Land. Pressure at the surface averaged 5 mb (.15″) below normal in the Hudson Bay sector. To the west of this feature low pressure extended on a broad front to northern Alaska where another even deeper vortex prevailed over the Beaufort Sea with a steep trough extending southward into the western Gulf of Alaska. The dominance of low pressure across the American Arctic produced a west-southwest flow of maritime air from the eastern Gulf of Alaska, across the Rocky Mountains, and into the central basin of Canada. This fast jet flow of Pacific air prevented any incursions of Arctic air from the cold reservoir usually found over the icy northern seas at this time of year. The maritime air from the Pacific, divested of its moisture and warmed in its descent from the Rockies, kept temperatures well above normal over most of central and southern Canada as well as over the immediate United States border sections.

As these modified air masses moved southeast into the Missouri-Mississippi Valleys and into the region of the central U. S. trough, they were colder relative to the normal for the more southerly latitudes. In



Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.



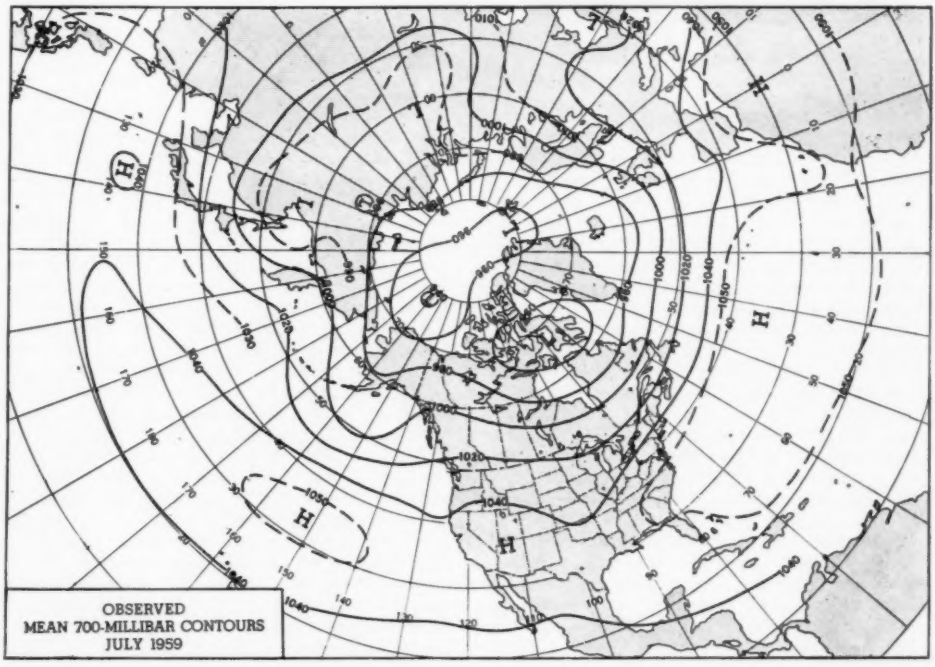
Total Precipitation in inches. USWB chart.

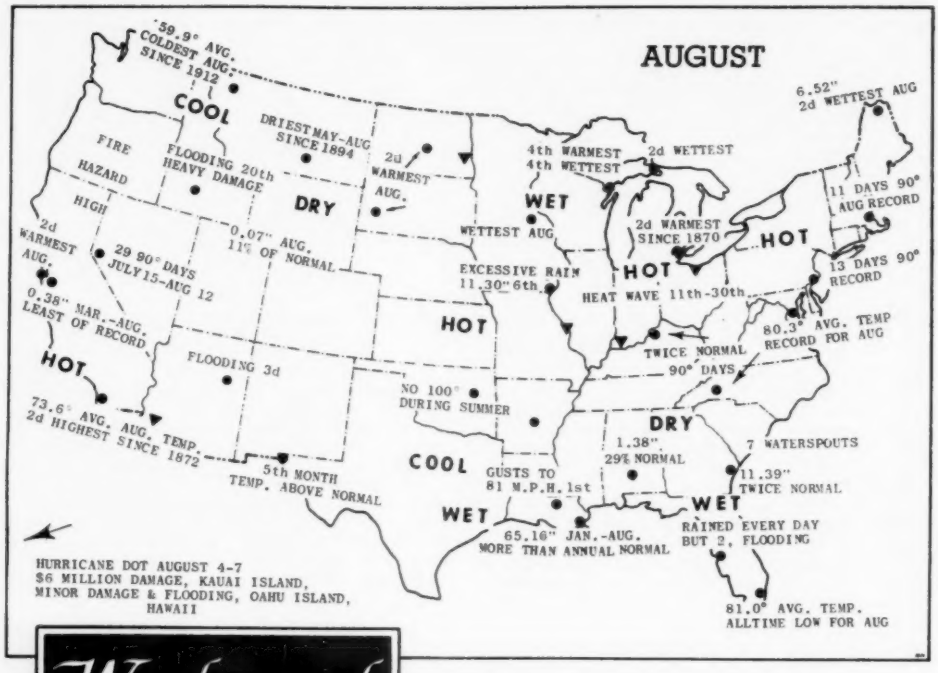
Kansas and Nebraska they encountered a flow of moist Gulf air which had been drawn northward into the central trough, producing cloudiness and rainfall to shut out the usual daytime heating. July was decided cool from South Dakota and southern Minnesota southward to the Gulf of Mexico. In eastern Kansas the mercury averaged as much as 6 degrees below normal and a large area touching five states had departures in excess of 4 degrees below. The Gulf air with its moisture load could not penetrate west of 95° W in the northern Plains nor beyond 100° W in the central Plains. Though excessive rainfall resulted in Oklahoma and practically all of Texas received at least two inches, the western Plains (including western Nebraska, most of the Dakotas, and all Montana) had less than one inch at this critical period in crop development.

On the West Coast air flow over the northern Pacific States also had a westerly component so temperatures along the immediate coast clung close to normal, but inland ran somewhat higher as ridge conditions maintained sunny skies and permitted maximum insolation. In California and southern

(*Continued on page 211*)

The upper-air map below shows the pattern of air flow for July at about 10,000 feet, on which the average weather largely depends. The contours lines represent the mean height of the 700 mb. pressure level. Figures are in tens of feet: 1020 = 10,200 ft., 980 = 9,800 ft., etc. Chart by Extended Forecast Section, USWB.





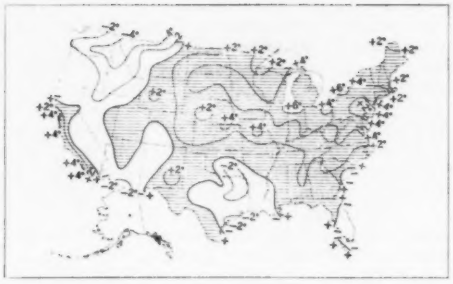
Weatherwatch

The July circulation pattern, a western ridge-central trough-eastern ridge, held sway well into August, but the marked temperature regimes which sectionalized the country in July gradually became less distinct during the first days of August. For the week ending the 10th, the cold pole of the nation centered in the Middle Atlantic States, the central valleys heated up from the cold spell of July, but the California coast continued much above normal.

During the first ten days of August the most interesting feature of the weather charts centered in an upper-air vortex of low pressure which hovered over the Northeast, from offshore New England on the 3rd to the Lower Lakes on the 10th, controlling the weather for a full week. Movement of Canadian air into the vortex kept temperatures low over the Northeast, and onshore flow of maritime air produced excessive cloudiness and precipitation for the first ten days. In the South a frontal zone over Georgia and Florida produced much cloudiness and precipitation from the 8th to the 12th.

The circulation pattern changed with dramatic effect on the 10–11th. The appearance of a low circulation off the southern British Columbia coast signaled the breakdown of the western ridge regime and the advent of trough conditions over the Far West. From the 12th to the end of the month the weather map wore a western trough-eastern ridge face. From the 17th to the 21st the Pacific States trough developed marked strength with a long, oval-shaped, closed circulation aloft prevailing on the 19th and 20th. This unusual summer configuration brought record cold air into the Northwest and southward to central California and Nevada with snowfall in the central Sierras and new low August temperature marks at several places. The presence of the western trough continued southwesterly flow on the immediate coast to add August 1959 to the long string of warmer-than-normal months.

The cold regime, which had made July vacation weather miserable in the East, vanished on the 11–12th as ridge conditions built up over the Ohio Valley and the Appalachians; anticyclonic southwesterly flow replaced cyclonic northerly and easterly circulation. This marked the commencement of a record string of consecutive hot days for any August. From the trough feature over the Far West southwesterly winds had a long sweep over the hot prairies and plains. In the Midwest there were no intrusions of Canadian air masses to ameliorate, even temporarily, their hot content, and the position of the upper-air contours occasionally permitted the



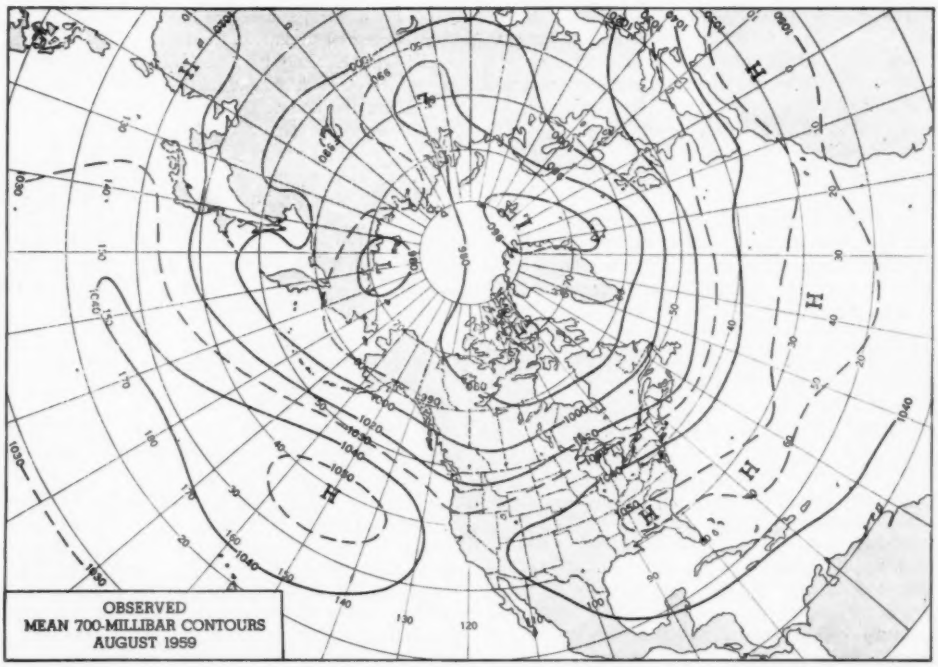
Departure of Average Temperature from normal in degrees Fahrenheit. USWB chart.

Total Precipitation in inches. USWB chart.

introduction of southerly flow from the Gulf of Mexico, adding a high moisture content to the heat to keep the temperature-humidity index at high levels over most of the Mississippi Valley and all of the East.

In the Northeast there were only three minor penetrations of Canadian air. On the 18th a surface front reached to Virginia to give momentary cooling to areas north of the Mason-Dixon Line and east of Chicago. On the 22–23rd a front pushed down the eastern seaboard to reach an advanced stage on the Cape Hatteras-Pittsburgh line. Though it gave the Nation's Capital a respite from 90°-plus weather, the hot air inland quickly pushed the front seaward. On the final two days of August the heat moderated somewhat as a front pushed southeastward over the Great Lakes as far as the New York City-Nashville line on the 31st before retreating northward as a warm bulge. Though the final air mass change knocked down daily maxima, the humidity remained high, the new air soon warmed, and the uncomfortable late summer of the East and Midwest extended into September.

DOT—Hurricane Dot, one of the most violent cyclones to affect the Hawaiian Islands in recent years,



formed in the southeastern North Pacific Ocean between Mexico and Hawaii. It was discovered approximately 1200 statute miles east-southeast of Honolulu by the *SS Sonoma* on 1 August 1959. A plane of the U. S. Air Force 55th Reconnaissance Squadron penetrated the storm on 2 August and found winds of 120 knots near the center.

As the hurricane moved toward Hawaii, the Air Force made three fixes on its location each day. This excellent reconnaissance coverage permitted the Weather Bureau's Hurricane Warning Center at Honolulu to chart the storm through the area east of Hawaii where there were virtually no other data available. Warnings to all of the Islands were issued well in advance.

Dot skirted the south side of the Island of Hawaii during the night of 4–5 August, moving on a course slightly north of west and attended by gales, high surf, and moderately heavy rain on the southeastern side of the Island. At its closest approach the center was 90 miles south of Hawaii.

On the 5th Dot continued moving in a general west-northwest direction at 10 mph. Central pressure on the 3rd was estimated by aircraft to be 959 mb (28.32″); maximum winds were near 120 knots or 137 mph. The track took the center well to the south of the Islands of Maui, Lanai, and Molokai. A curve to the north took place south of Oahu to carry the center about 75 miles west of the most densely populated island in the new State. Honolulu experienced its highest winds (52 mph sustained one-minute and gusts to 65 mph) about 1440 on the 6th, and pressure fell to 1008 mb (29.77″). The storm continued north-northwest at 10 knots on the 6th and passed directly over the weather station at Lihue Airport on Kauai Island on the evening of the 6th. Winds reached a one-minute sustained force of 73 mph from the northeast and pressure dropped to 991 mb (29.25″). The storm had already lost some of its energy and declined considerably in passing over the island. Early on the 7th it moved off to the northwest with greatly diminished intensity.

No deaths or injuries have been reported as a direct result of the hurricane. Newspapers reported property damages on Kauai at $6 million. Surf, local flooding, and high winds all caused extensive damage, particularly on the eastern half of the island. Homes and other buildings were damaged, hundreds of trees blown down, many roads washed out, and there were severe agricultural losses in fruit trees and sugar cane. Minor damage reports came from Oahu and Hawaii.

HEAT—August averaged warmer than normal over more than three-quarters of the land area of the contiguous 48 states. Only in the Northwest from central Montana to the Pacific Coast and in adjoining areas of Texas, Oklahoma, Arkansas, and Louisiana were significant below normal reports made. From the central and northern Rocky Mountains eastward to the Atlantic Coast and southeastward to the middle Gulf Coast, August was a memorable month not only for a protracted heat wave, but also for unrelieved high humidity.

The greatest departures from normal were observed along the southern shores of the lower Great Lakes. South Bend, Indiana, after ten days of relatively cool weather, commenced a record heat wave on the 11th with above normal temperature on every day to the end of the month. The mean temperature for the month ran 5.4 degrees above normal, a new record of 11 consecutive days with 90° or more was set from the 19th to the 29th. The highest of the month, 96°, was not unusual, but the nighttime temperatures remained very high. On the 26th and the 29th, the departure from normal reached plus 14 degrees. At Detroit it was the warmest August since 1947 and the second warmest since 1870. At Erie, Pennsylvania, it was the 2nd warmest (exceeded only by 1947), and the fourth driest. At Washington, D. C., the heat wave commenced on the 12th and continued through the end of the month to equal the previous record for highest mean August temperature set in 1947. There were eleven consecutive days with 90° or more from the 12th to the 25th, a total of 16 days with 90° or more, and an absolute maxima of 96° on three days. It was the same story all over the Middle West, Middle Atlantic States, and New England. Greatest complaints were caused by the continuing high humidities which gave the new temperature-humidity index a real workout. The heat spell in the East continued unbroken into September.

In the Far West it was a cool month with the exception of the heavily populated areas of California where the long-continued heat regime again set new marks in August. Downtown San Francisco had its second warmest August since 1871; San Diego its second warmest August since 1872; at Los Angeles Airport it was the second hottest month ever reported and the hottest August; and downtown Los Angeles showed a plus 2.6° departure to make this August the 4th warmest there since 1877.

By way of contrast, Oklahoma City had no 100° readings this summer, but Bismarck, far to the north in North Dakota, had five such days in August alone. There were some searing days on the central and northern Great Plains in August. On the 3rd and 4th Kansas heated up to 110°, and on the 18th in South Dakota Vivian had 112° and Pierre 111°. From the Northwestern cool area, Kalispell at 2965′ in northwestern Montana sent in the following: "The temperature averaged was below normal on nearly every day during the month, with the monthly average lower than for any other August since 1912. Some spotty frost occurred in parts of the valley on the 29th, and a quite general freeze occurred on the 30th. Only slight damage to gardens was reported." Kalispell's August average ran −4.1° below normal, with a minimum of 31° on the 30th. An August snow storm swept the high Sierras of central California on the 19–20th. At the other end of the country, Miami Airport broke its all-time low record for August with a chilly 70° on the 5th and it plumeted to 69° at Miami Beach on the 22nd!

July (*Continued from page 207*)

California the situation differed. Along the coast air flow had a more southwesterly direction as a minor trough persisted offshore from 42° southward. Inland ridge conditions aloft held a tenacious grip over that area without a break from 4 July to the end of the month. At the same time the usual summer thermal low over the desert Southwest developed marked posture. The vertical stacking of these two features produced very warm surface temperatures. At Yuma, in the lower Colorado Valley, it was the warmest month ever experienced, and along the lower Southern California coast the remarkable string of warm months continued. At Los Angeles Airport the last month with below normal averages occurred in April 1956!

On the eastern side of the central trough, a broad southwesterly flow aloft prevailed over the Appalachians and the Northeast. This kept mean monthly temperatures above normal in the Middle Atlantic and New England States. Nevertheless, a blocking feature periodically took control over the Gulf of Maine and the Maritime Provinces where surface pressure averaged 4 mb (.12″) above normal. Eastward-moving troughs and fronts were often delayed or stalled, causing onshore circulation along the immediate coast with accompanying cloudiness and heavy rainfall. Along the New England shoreline it was a disappointing vacation time. From Cape Hatteras southward to Florida a southeasterly current out of the Bermuda-Azores high brought a distinct maritime influence to those shores. Rainfall was heavy and temperatures below normal.

CALIFORNIA HEAT—Bob Elford, State Climatologist, reported from San Francisco: "Abnormally warm weather marked the month of July in several areas of California. The south coast had the warmest July of record, and Los Angeles reported the warmest month of any name. Some points in the central Sierra Nevadas also reported record-breaking average temperatures for the month. Record high temperatures for specific dates were established at several points along the south coast. In the northern part of the State Red Bluff established a new record with 24 consecutive days with maximum readings of 100 degrees or higher. Mt. Shasta had 21 days with the maxima of 90 or above. Blue Canyon had the warmest July of record, and Sacramento experienced the 5th warmest July in the records." The hottest day of the month along the coast occurred on the 10th: San Diego 93°, Long Beach 105°, Los Angeles Airport 97°, L. A. Downtown 103°, Santa Maria 93°, San Francisco Airport 97°, and S. F. Downtown 92°. Back on the California-Arizona border at Yuma it was the hottest month ever recorded. The daily maximum averaged 109.4°, the lowest maximum was 101°, mean monthly 96.7°, and from 30 June to 29 July the minimum was 81° or higher. Peak reading also came on the 10th with 118°.

CINDY—A small tropical cyclone formed off the coast of South Carolina on 5 July and reached tropical storm stature on the 7th. Highest winds in squalls near the center were estimated at 60 to 65 mph, and by the morning of the 8th central pressure was down to 996 mb (29.42″). Gale warnings and a hurricane watch were ordered from Cape Hatteras to Charleston.

The center moved very slowly from the 5th to the 8th, performing a reverse S curve, but on the 8th moved definitely westward toward the central South Carolina coast with winds near the center at 70–75 mph. The center moved inland near McClellanville (between Georgetown and Charleston) about 2130 EST on the 8th, attended by whole gale force winds, tides up to four feet above normal, and heavy rain. Cindy marked a slow pace over central South Carolina on the 9th, recurved to the north and then northeast, and crossed east-central North Carolina on the 10th. In the company of a friendly trough, the center passed near Norfolk, Virginia, about 1500 on the 10th, speeding northeast offshore and deepening, to pass just west of Nantucket Island on the morning of the 11th with the lowest pressure there at 1001 mb (29.56″). Cindy was a remarkable rain-producer at times. In central South Carolina, Columbia Airport measured 5.81″ on the 9–10th "with an unofficial but reliable 15 inches reported fourteen miles east." Atlantic City Airport, well west of the center, had 6.46″ on the 10th. This storm total helped to boost the July figures at the New Jersey resort to 15.69″ to make July 1959 the wettest month ever experienced in 86 years of record!

DEBRA—Hurricane Debra, small in size and erratic in movement, developed east of the central Texas coast on 23 July as an easterly wave moved across the Gulf of Mexico. Early on the 24th the center moved norwestward toward Matagorda Bay, then northeastward parallel to the coast, and finally northward to make a landfall about midnight between Freeport and Galveston. The Freeport Coast Guard reported a gust to 93 mph and the Galveston Weather Bureau had 85 mph. Lowest pressure at Galveston Airport was 1000 mb (29.52″). The center moved about 20–25 miles southwest and west of Galveston, and a short distance to the east of Houston. Normal activities in both cities were suspended for a day and much minor damage occurred. Press estimates ran into the millions. Debra was also a good rain-producer. Houston Airport had a storm total of 8.98″ and a cooperative station at Orange reported 14.42″. Debra continued a northerly track through east Texas close to the 95° W meridian and then moved northwestward across central Oklahoma. It produced heavy rainfall in its dying stages over much of the southern Plains. Totals around 15″ were reported from several places in northeast Texas and Louisiana and around 8″ in Oklahoma. Cindy dropped 5.94″ at downtown New Orleans to assist in boosting the July total there to a record 18.16″, the greatest ever registered in a July.

Adventures (*Continued from page 187*)

Dendrochronology in the Connecticut Valley and Its Correlation with Solar and Terrestial Weather Effects

John A. Wiles, Central H. S., London, England, APO 196, New York, N. Y.

A study was made of elm, sycamore, and willow trees in the vicinity of Windsor, Connecticut. It was found that there were four major variables affecting tree ring growth. These were rainfall, sunshine percentage, temperature, and sunspots. Rainfall showed a relation to tree ring growth. Percentage of sunshine corresponded inversely to peaks in ring growth. In many years under study, sunspots cycles followed the same pattern as rainfall, and hence, ring growth. Temperature appeared to have little noticeable effect on ring growth.

Electrification Development During the Crystallization of Pentaerythritol

R. David Munch, Webster Groves H. S., Webster Groves, Missouri

The tetrahedral crystals formed in a pentaerythritol and water solution have electrical properties. This negative charge develops during the crystallization and is only present while the crystals are growing. The potential difference developed by a single crystal ranges from 10 to 5×10^3 volts and varies with the size of the crystal. The distance apart of these crystals varies with their voltage and may be affected by potentials as low as 150 volts D.C. The crystals form with a pyramidal shape with their square base up at the surface of the solution and the vertex down in the solution.

Electrification Development in Trioxane Crystals

Louis J. Cutrona, Jr., Ann Arbor H. S., Ann Arbor, Michigan

Previous experiments showed that, when properly handled, the substance trioxane can be made to form long, needle-like crystals with high electrification at the tips. Various attempted methods of growing these crystals are discussed. Several characteristic phenomena of the growing crystals are mentioned. Different types of crystals observed growing within the chamber are described. An attempt to measure the magnitude of the charges on the crystals is related. Suggestions as to further possibilities in research projects along these lines are briefly mentioned.

Light Scattering by Clouds in the Northern Sky

Robert T. Shiozaki, Manual H. S., Denver, Colorado

By studying the light scattering by clouds in the Northern Sky, the author has found some relationships between types of clouds and the amount of scattered sunlight. It was generally observed that as the thickness of clouds increased, more light was received. But if it became too thick, less light was recorded. Cumulus types of clouds reflect the greatest amount of sunlight. The amount of reflected radiation from the stratus clouds is less than that from cumulus clouds. Most clouds are observed to reflect more sunlight than the clear sky. The least light is recorded at the height of thunderstorms. Since this method of studying the movement of clouds is limited to just a small portion of the sky, new methods must be found in the future.

Methods of Collecting and Transporting Hailstones for Scientific Studies

Anthony R. McClimans, Niskayuna H. S., Schenectady, N. Y.

The principles behind and designs of containers for hailstones during storage and shipment. Small styrofoam boxes, refrigerated with dry ice, were experimented with, but were proven inefficient. A large cardboard box filled with newspapers and refrigerated with dry ice proved to be useful.

Radioactive Probe Currents and Potential Gradient Related to Storms and Fair Weather

Eugene M. Wengert, High Point H. S., Beltsville, Maryland

A direct correlation between atmospheric current and potential gradient is discussed. An inexpensive method for measuring atmospheric current is described.

Reports of weather conditions and corresponding atmospheric electricity are presented, including the effect of individual clouds on the readings as observed in Windsor, Connecticut.

The final section of the paper relates the authors' views on the future possibilities of atmospheric electricity readings with special emphasis on detection and prediction of lightning storms.

Relationship of Atmospheric Nuclei to Air Pollution Problems

Thomas R. Defler, Golden H. S., Golden, Colorado

A series of readings of condensation nuclei were made from 29 June 1959 to 4 August 1959 at the Loomis School in Windsor, Connecticut. The ob-

servations were compared to local weather and to data collected at Bradley Field, 3½ miles northwest of the School. The three highest nuclei counts were found to be associated with major cold fronts crossing the region. Correlations were also made between the nuclei counts and the dew point and relative humidity. Condensation nuclei readings showed that the period of observations could be roughly divided into three categories: a variable period, a period without great fluctuation and another variable period. The dew point seems to follow the same variability.

Replicas of Ice Crystals Formed in a Laboratory Cold Chamber

Thomas R. Kelly, Davis Joint Union H. S., Davis, California

Crystals formed by different seeding methods are usually of different shapes. Crystals formed by seeding with AgI are usually more detailed in design than those formed by any other method I have used. All crystals formed by seeding with AgI are hexagonal plates. Crystals formed by using rapidly expanding gas to cool the cloud below −40° C are also hexagonal plates but are not as consistently detailed, some being without a pattern at all. Crystals resulting from dry ice seeding are hexagonal columns, not plates. When the nucleus of the crystal is a dust particle, the crystals are irregular and larger than those formed by the other method. Static electricity, electricity and the Tesla coil tend to line up the crystals while they are in the cloud.

Studies of the Evaporation Reduction from Water Surfaces

Robert M. Hadsell, Mohonasen H. S., Schenectady, New York

This paper discusses the nature of a hexadecanol monolayer as an evaporation-reduction agent under laboratory and field conditions. Attempts to discover a method for showing long-term pressure changes in the monolayer are described. On a field level, powdered hexadecanol was applied to a pond from a cheesecloth bag suspended from a helium-filled balloon. Results of this application are noted. Finally, a possible method of detecting the fall of pressure below a minimum level is discussed, including the application of this method to an automatic hexadecanol-dispensing device.

Supercooling and Related Crystal Growth

Michael W. Meister, Jacksonville, Florida

The property of supercooling, which is found in most substances that crystallize from the melt, can be easily demonstrated and studied through the use of some of the common hydrates. Those used consisted of calcium chloride, sodium thiosulphate (hypo), and sodium sulphate. Both the ease with which these chemicals supercool and their relatively low melting points aid in the ease with which studies may be carried out.

With simple equipment, spontaneous nucleation and nucleation through seeding as it occurs in the supercooled liquid may be studied, and some properties of crystal growth and polarization may be observed.

Using sodium sulphate, an interesting phenomenon of a progressive change in crystal phase may be shown.

Techniques for Studying Clouds by the Use of Water Analogs

Robert A. Singer, Sewanhaka H. S., Elmont, New York

In this project, a water medium and a silver chloride suspension were used to simulate atmospheric conditions. With these materials, some basic atmospheric phenomena were studied. On the basis of my observations, I was able to reach the following conclusions:

During the convective stage of a cumulus cloud, there is a considerable flow upward. This flow causes entrainment, pulling in particles at all sides of the rising stream.

Stability layers, by repressing the upward growth of a convective cloud, cause it to rotate and form shelf-like projections. This seems to relate to the formation of tornadoes.

Light entrainment caused by sporadic convection produces bead-like formations which grow into developed vortices.

Anvils are formed when upward growth is prevented. This could explain the development of thunderheads.

The Behavior of Crystals in an Electric Field

Thomas J. Wilcox, St. Ignatius H. S., San Francisco, California

In this paper the author is concerned primarily with the design of devices and the procedures used in the study of the effects of electrical fields upon crystal structure.

The Behavior of Water Droplets in Electric Fields

James M. Schaefer, Christian Brothers Academy, Schenectady, New York

Water droplets, when sprayed into an intensified electric field of an A.C. ripple D.C. current, will form "fibers" of water. Various ways of rigging the electrodes were tried, and a different effect of "ellipses" was formed. Experimentation with strong soap bubble on the electrode was tried.

The Bounce and Coalescence of Water Drops Ejected from Vertical and Inclined Pipettes

Harold L. Petrie, North H. S.,
Denver, Colorado

The vertical and inclined jets were affected by electric fields, dust, and wetting agents. The effect of electricity varied with the voltage. A low voltage caused coalescence; a high voltage caused dispersion. Dust and wetting agents caused coalescence. Two meeting streams acted much the same as the vertical jets.

The Bounce Effect of Droplets Skating on a Water Surface

Arthur B. Kliefoth, Thomas Jefferson H. S.,
San Antonio, Texas

Droplets of water about 1 mm in diameter projected onto a water surface can be observed moving on the surface without sinking. Collision of two droplets results in either coalescence of the drops or bounce-off. The number of coalescences with other drops or with the surface of the supporting medium is determined by surface tension, electricity, movement, impurities, and possibly the humidity conditions. Optical effects such as Newton's rings can be observed in the drop because of the supporting air gap.

The Construction and Operation of a Fire Danger Station

Charles F. Paul, Tower Hill School,
Wilmington, Delaware

The burning index is a measure of how readily a forest fire will start and spread. It is computed using relative humidity, wind speed, and fuel moisture as factors. In order to maintain uniformity, readings are taken under artificial conditions which can be exactly duplicated at many stations. The fire danger for Windsor, Connecticut, during July 1959, was generally low.

The Development and Preservation of Breath Patterns

Robert A. Berry, Harvey Lowry H. S.,
Inkster, Michigan

Using a dry ice chamber, glass slides, silver iodide crystals, and a solution of Formvar dissolved in ethylene dichloride, it is possible to make and preserve breath patterns formed by submicroscopic particles. This article describes how this process is accomplished and what possibilities it has in the field of meteorology.

The Diffusion of Water and Aqueous Solutions Through Cellophane Tubes

Hugh T. Field, Browne & Nichols School,
Boston, Mass.

A cellophane tube has pores of molecular size through which water can diffuse. The rate of this diffusion increases with temperature, and if wind is flowing past the outside surface of the tube, it decreases gradually as time increases. Diffusion is mostly from the liquid phase. Thicker cellophane tubes are less effective as a supply to a cold chamber in forming a supercooled cloud because they allow far less diffusion; large cellophane tubes take a little longer to freeze. Salt water and ferric chloride solutions were used in cellophane tubes in unsuccessful attempts to retard freezing. When salt-water was used, needles of salt (NaCl) formed on the outside of the tube; old salt needles were attracted to a positively charged glass rod.

The Electrification of Frost Crystals Formed on Cold Surfaces

Henry C. S. Lanford, Columbia H. S.,
Castleton, New York

This project is a study of electrification believed to exist in frost crystals grown on cold surfaces. Some preliminary work was done with the electrification of water droplets ejected by bursting bubbles.

The observations have indicated that perhaps the electrification effects are due to induction charging resulting from the electrical field applied to measure charge.

Full details of a very simple and inexpensive but fully satisfactory arrangement for observing and measuring frost crystal charge are given. Its design follows basically the Millikan oil drop set-up and Blanchard's adaptation for water droplet studies.

The Formation and Study of Splash Patterns on Sooted Slides

William T. Smith, Mount Clemens H. S.,
Mount Clemens, Michigan

The study of splash patterns, the peculiar phenomenon which occurs when water drops are allowed to fall on specially sooted slides, was pursued in this project and many interesting effects were observed. It was discovered that when a drop hits a slide, it traps under it small air bubbles which are forced to the outside of the flattened drop. Also, it was observed that small droplets break away from the main drop when it hits and these droplets behave in a most unusual fashion. It is proposed, with some basis of proof, that their behavior is controlled at least to some degree by some sort of electrification.

The Formation of "Cobwebs" by the Electrification of Carbon Smoke Particles

Doug M. Jewett, Madison East Senior H. S.,
Madison, Wisconsin

The "carbon cobweb" effect, produced when carbon smoke is subjected to the discharge of a Tesla coil, was investigated. Several types of smoke were used.

Curious "ducking particles" and Bénard cells were produced when a discharging Tesla coil electrode was brought near a carbon tetrachloride surface that had been dusted with fine carbon particles.

These surface effects should be studied further to determine what changes take place on a liquid surface due to electrification.

The Formation of Fibrous Crystals from an Inorganic Salt

Steven B. Caldwell, Columbia H. S., Rensselaer, New York

Studies were made of the rates of diffusion of solutions of salts such as sodium chloride through semipermeable membranes into air. Various concentrations of salts were studied. The rate of diffusion observed formed exponential curves when plotted against the amount of salt in the solution.

Saturated solutions of certain salts such as sodium chloride, sodium bromide and potassium chloride formed long fibrous needle-like crystals which projected into the air from the surface of the semipermeable membrane. These fibers are birefringent and rectangular in form and have been grown to lengths of several centimeters.

The Origin of Radar Echoes in the Connecticut Valley

C. David Schweickart, Bishop Watterson H. S., Worthington, Ohio

Radar echoes for the summers of 1958 and 1959 were analyzed with special emphasis on their place of origin. Some conclusions were reached concerning the effect of topographical features on the number and intensity of echoes, the time of origination, and the variation in this time as the season advanced.

The Preparation of Large and Small Bubbles for Air Motion Studies

Joseph C. McCarthy, St. John's H. S., Jackson, Michigan

Using an idea of Dr. Vincent J. Schaefer's, I came upon the project of testing soap bubbles. Taking his suggested ingredients, I found a suitable formula for a bubble solution. I tested bubbles of all sizes. My aim was to see if they could efficiently trace drainage winds.

The Preparation of Photomicrographs Using Simple Home-made Equipment

Alfred J. Mateczun, Albuquerque H. S., Albuquerque, New Mexico

As a result of experimentation with an easily duplicated photomicrographic unit, many inter-relations concerning the components of the unit were discovered. To obtain a reasonably short exposure time, a fairly bright light source is necessary. Exposure time is also related to the magnification of the objective lens used and to a lesser extent on distance from eyepiece to film. Good image reproduction was obtained using contrast process panchromatic film, but a faster film could be used if it is wished to sacrifice a small degree of contrast for speed.

The Structure of Hailstones and Other Ice Formations as Shown by the Replica Method

Page R. Painter, Davis H. S., Davis, California

Plastic replica films were found to be very valuable in studying the structure of ice composed of small crystals. When hailstones were studied by this method, it was shown that their layer formation is due to variations in the crystal size. Evidence was also found that hailstones originate as raindrops. A study of hydromites revealed interesting structural patterns but no connections between their layer formation and hailstone structure.

The Use of the Langmuir Trough and Indicator Oils in the Study of Small Droplets and Aerosols

Anthony M. Musto, St. Peters Preparatory School, Jersey City, New Jersey

As a result of this project it was concluded that the ideal apparatus for experiments in surface chemistry is the Langmuir Trough. This trough, used in connection with indicator oils, provides an excellent method of studying the behavior of surface-active materials and detecting impurities in the air and in the water.

It was found that the relation between the diameter of an aerosol spot on the water and that of the droplet from which it was formed was an exponential function. The films were used to show the size of the spots, and the size of the spots was computed from this.

Weather Instrumentation and Observations

Richard W. Whitfield, Choate School, Rye, New York

In this paper, a presentation will be made of the various weather instruments employed for observational purposes which were encountered by the author during the Atmospheric Sciences Program. A short description and report on each is included. Techniques which have been found useful in the employment of these instruments will be related.

A summary will be given of the weather throughout the Program, with a description of several phenomena which occurred, together with synoptic charts which support personal opinions regarding the phenomena.

A conclusion is presented, in which the author's opinions concerning the significance of the observations made here are presented, as well as a description of instrumentation necessary for various weather stations.

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AMS School Program for 1960

The success of the AMS-Loomis School Atmospheric Sciences Program for 1959 has led the AMS to recommend that an expanded program be undertaken in 1960. In addition to an Eastern location, several universities with meteorological facilities have been encouraged to submit proposals to conduct programs in other sections of the country. These would be sponsored by the National Science Foundation.

The AMS hopes that those who have gained an insight into meteorological research problems at the AMS-Loomis School in the past summer will continue their work in this field. An advanced program for them has been suggested under the sponsorship of an outstanding technical institution. Several universities have indicated that they could employ these students to good advantage in some of their meteorological research programs during the summer of 1960.

Awards for Undergraduates

The AMS has announced the Father James B. Macelwane Annual Awards in Meteorology. Three prizes of $150, $100, and $50 will be awarded for original papers on any phase of meteorology. The contest is opened only to registered undergraduates in any college or university in the Americas. Entries will be accepted up to 1 February 1960. All papers should be submitted to the chairman of judges, Prof. Jerome Spar, New York University, New York 53, N. Y.

Student Trainees

Opportunities will be open in 1960 for student trainees in cooperative work study programs in meteorology and oceanography. There are two types of programs available: (1) Cooperative work-study programs in which there is integration of academic program with practical work and training in a regular Government position. For a period, usually five years, the student alternates in attendance at college and work in a scientific Government job; (2) In the vacation work-study program the college student spends his vacation period in regular employment in a Government position, but returns to college

for the advancement of his academic progress. The U. S. Weather Bureau usually has openings in both the above program. All interested may secure detailed information from the American Meteorological Society or from the U. S. Civil Service Commission, Washington 25, D. C. Ask for Announcement No. 205.

Agricultural Meteorology

A 32-page pamphlet, *The Agricultural Weather Station*, was issued in June as Bulletin No. 537, June 1959, by the Agricultural Experiment Station, University of Wisconsin, Madison. The publication summarizes studies made under the direction of the North Central Technical Committee, NC-26, on "Weather Information for Agriculture." The report was prepared by a subcommittee on instrumentation consisting of Prof. J. E. Newman of Indiana, chairman; Prof. R. H. Shaw of Iowa; and Prof. V. E. Suomi of Wisconsin.

"The primary purpose of this publication is to set forth the necessary observations, instrumentation, and exposure requirements of an agricultural weather station. This bulletin proposes what is believed to be an adequate set of observations for general use in technical agriculture. It is granted that in specific experiments other observations will be necessary too."

The pamphlet consists of four main sections: Location of agricultural weather stations, Observations and instrumentation, Recording data, and Essential observations for a selected network of cooperative agricultural weather stations. An appendix, list of references, and sources of instruments are included.

Cloud Seeding

There is "strong justification for conducting cloud-seeding experiments in all states having high mountain ranges" according to the final report of the President's Advisory Committee on Weather Control.

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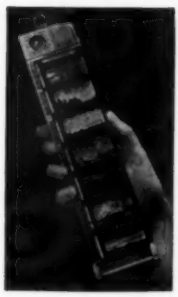

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